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ELECTRICAL WORLD AND ENGINEER.

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For the benefit of such readers as may care to file weekly for reference a list of contents of this journal, we shall reprint in each issue, commencing with the present one, a list of contents of the preceding issue. The list will be printed of such a size that when cut out it may be pasted on the standard library card, which cards can be obtained at almost any stationery store. At times when the contents as printed on this page would require more space than the dimensions of a card will permit, it will be shortened for reprinting by omitting less important references to the text. The list will be printed in the advertising portion of the paper to avoid clipping the reading text, and its location may vary, owing to the exigencies of "make-up," from week to week.

THE NEW YORK CENTRAL.

After a brisk little discussion, the stages in which are elsewhere noted, Mayor Low has accepted in behalf of the city the Apgar bill now before the New York Legislature fixing May 1, 1905, as the date after which it will become unlawful to use steam in the Park Avenue terminal tunnel. This is surely liberal allowance enough. If the railroad company were in dead earnest about the thing the change could easily be made long before that time. We should have preferred to see a much earlier date fixed, believing that there would be no unreasonableness in such pressure; but Mayor Low is evidently anxious to be fair and to have the reform shape in with the other transportation improvements now being effected in the city. For three years more, then, those who have to pass through the tunnel must endure the inconveniences of that dirty and dismal smoke sewer, and make the best they can of it. It seems a great pity that this must be so, and that electricity was not resorted to long ago. There may be mitigations of the evils of steam, but the only real cure is to stop using it.

In making its plea for more time, in the letter signed by eight of its directors. the New York Central Company makes a curious statement to the effect that it is advised that electricity cannot handle its trains yet satisfactorily. We quote the passage elsewhere. It might be true in regard to through trains, but seeing that the whole question is the handling of trains when they reach the tunnel, we are puzzled to discover what such a statement has to do with the case. On the face of it, it looks like a disingenuous plea for delay, but we should be slow to suggest that in view of the solemn pledge otherwise given by the eight directors. Meantime, it would be interesting to know who the electrical engineer is—if there really be one—who advises the company that electricity cannot handle easily every one of its trains—local, through, etc.—in the tunnel, or even in the suburban area. We take it upon ourselves to assert flatly, without any fear of contradiction, that Messrs. Arnold and Sprague never gave any such advice. So far as the public is aware, no one else has ever been called upon for an opinion professionally; and even the extent to which the reference to these two engineers has gone is more or less indirect, or a matter of doubt. Mr. Arnold has certainly done some work for the company, and he is an outspoken advocate of the adoption of electricity for traction. The New York Central owe it to the electrical profession at least, to give up the name of the electrical engineer, who, according to them, is literally "fouling his own nest." We hear the view freely expressed in electrical circles that the company have never had any such advice from any electrical engineer whose professional opinion is worth 10 cents.

ATMOSPHERIC CONDUCTIVE STRATA.

Elsewhere we print an interesting communication from Dr. Kennelly on the subject of conducting atmospheric strata, and the influence of the same with respect to wireless telegraphy. From the earliest days of wireless telegraphy the manner in which etheric waves of the Hertzian order are transmitted through the atmosphere has been a subject of lively interest. By some it was held that unless a portion of the terminal antennæ projected above a plane tangent to the earth midway between stations, transmission was impossible, and some experiments made in Belgium to test this assumption were held to have verified it. One result of the recent brilliant experiments of Marconi has been effectually to dispose of theories which considered the height of antennæ a definite function of the distance between stations. Dr. Kennelly points out that reasonable grounds exist for the assumption that in transoceanic wireless telegraphy the waves in their course are reflected, on the one hand, by the electrical conducting surface of the ocean, and on the other hand by the surfaces of upper atmospheric strata, which latter, by virtue of their rarefaction, approach sea water in conductivity. The deduction from this view is, therefore, that the curvature of the earth plays no important part in transoceanic wireless telegraphy, that the propagation of the signaling waves is cylindrical, and that the attenuation of the effective waves is in simple proportion to the distance traversed by the waves.

The figures given of the conductivity of rarefied strata are most interesting in view of the claims that have been put forth as to the possibility of utilizing the upper strata of the atmosphere for the economic transmission of electrical energy in large quantities. Such claims have been vague as to the height of elevated transmission termini—in fact, merely specifying that they should extend into the rarefied atmosphere. According to figures given by Dr. Kennelly as deduced from data determined by Professor J. J. Thomson, at a height of from 45 to 55 miles above the surface of the earth, the conductivity of the atmosphere for low-frequency alternating currents is about 600,000 times less than the conductivity of copper. As to the conductivity of atmospheric strata at an altitude of but a few miles, we do not think its value would be of an order to cause the engineers of a Himalayan transmission project to fear that measurable shunts of energy would occur across high-voltage pole-line conductors. Indeed, one of the mountainous regions of the world would furnish an ideal field for a test of the upper-strata transmission of power theory; for if not successful there, we could hardly hope to attain a sufficient altitude for the transmission termini in habitable regions of the earth.

THE WATTMETER ON INDUCTION MOTORS.

We printed last week a group of communications on metering three-phase currents which, together with those of Messrs. Taylor and Brandeis printed in this issue, will well repay examination on the part of many of our readers. In the early days of the system the whole matter was very imperfectly understood, and more than one station manager was brought to the verge of nervous prostration in trying to extract coherent readings from his wattmeters. Without going in detail into the concrete case discussed by our correspondent, the fundamental thing to remember in dealing with three-phase circuits is that the several currents must be measured in connection with their allied voltages if a correct reading is to be obtained. One would not think of trying to meter an alternating-current circuit by taking the current belonging to one customer and combining it with the voltage on the lines of another customer. Yet this is substantially the thing which often happens in carelessly connecting to three-phase circuits. In one case that came to our notice, an induction motor of about 5 hp was connected to a meter by using the current in one branch and the voltage across the two other branches. All was well until the bills were rendered—then the customer smiled happily and said nothing, and the station manager groaned in spirit and was sad. At last the truth came out, and to this day the manager has not been able to convince the customer that he is not the victim of soulless corporate greed in the sudden increase of his bills. The safest course to follow in the average station not extensive enough to have a meter expert is to put the installation of meters into the hands of one intelligent man and direct him to study thoroughly the directions given by the manufacturers and to paste their connection diagram for three-phase circuits into his hat and follow in slavishly tracing out every connection until he is sure that his wiring and the diagram exactly correspond. Properly connected the wattmeters will tell the truth to a close percentage, and if they give an unexpectedly low result on induction motors it is well to suspend sentence on the meters until one is quite sure that the motors are carrying a disproportionately large real load. The wattmeter does not punish a bad power factor, and it behooves those who furnish electric power to keep close track of the character of the motors on their circuits, and either to exclude the bad ones or to use a system of charging that will take account of unreasonably large demands for current.

THE POWER OF INCANDESCENT LAMPS.

Just at the present stage of events, there seems to be a reopening of the old question as to the extent of sub-division which is desirable in practical illumination. Almost from the beginning of the art the usual unit in incandescent lamps has been 16 cp. This figure was very naturally adopted from the ordinary legal requirements for gas, and as a matter of fact it seems to answer well for most requirements. But once given a convenient method of sub-dividing the electric light, the advantage to be gained by distribution in small units became at once a pertinent subject of study. So long as the requirement in illuminating a given space is based upon a fixed minimum intensity of illumination, sub-division has very obvious advantages. For evidently upon this specification, that distribution requires the least energy which exceeds the required minimum at the fewest points, and by the least amount of these points. Hence assuming that incandescent lamps do not change materially in efficiency as the size of the unit varies, lamps of small capacity will evidently give the best economic result so far as energy required is concerned. The compensating factors are the extra cost of wiring and of lamp replacement when the number of lamps is increased. Abroad, the result of experience has been the very extensive use of 8-cp lamps. The brilliant results attained by Mr. Stieringer at Buffalo last year with this same unit has demonstrated its economic importance. It is very doubtful whether any better effect would have been produced by an equal number of 16-cp lamps.

But the advance of electrical engineering has introduced new factors into this problem. While it is easy to produce an excellent 10-cp or 8-cp lamp at 110 to 120 volts, the task becomes difficult at 220 volts or more, and the advent of these higher pressures in the working conductors has tended to encourage the use of units even larger than 16 cp in order to obtain a durable lamp at a good efficiency. Still more recently the Nernst lamp has appeared, and all the experiments seem to point to the desirability of using units of 100 cp or more to gain the full advantage of the new construction. This situation at once raises a question of relative efficiency in practical use. In the illumination of a given space one has to judge by results, and if for the purpose in hand 100 10-cp incandescent lamps could give the same useful illumination as 20 100-cp Nernst lamps, then the two kinds of lamp could be on an economic parity irrespective of all nice questions involving watts per candle-power. The same dilemma

may be met in comparing incandescents with enclosed arcs, or in general any two classes of lights differing greatly in their capacity for convenient sub-division. Under at least conceivable circumstances a more complete sub-division may more than compensate for lower electrical efficiency.

On the other hand, the more powerful lights have in certain cases a material advantage. Wherever a large amount of light is needed at any one point a single large lamp is generally more efficient than several small ones. It seems to us that the possession of illuminants of great efficiency, but only moderate capacity for sub-division ought to encourage the indirect methods of illumination. Most of these modern powerful sources of light are of great intrinsic brilliancy as well as of great efficiency, and when used in the ordinary way have to be heavily shaded to reduce the glare. In indirect lighting they can be used bare, and the loss of the diffuse reflection will be hardly more considerable than that incurred by proper shading. Even incandescent lamps large or small generally require shading of some sort. It thus becomes quite possible for arcs, Nernst lamps or the like, to compete with even the most perfectly distributed incandescents in virtue of lighting mainly by diffusion. As a practical matter it would seem as if the incandescent lamps of very moderate candle-power, say, 8 or 10, could retain a stronger hold on the art, against competition, than those of larger capacity. The 16-cp lamp has too firm a position to be easily shaken out, and those of 20 to 32 cp are occasionally useful, but the inroads of competition are likely to be first felt in the large candle-powers, particularly if lighting by concealed lamps gains increased popularity.

ELECTRO-CHEMICAL INDUSTRIES.

The papers read at the last meeting of the American Institute of Electrical Engineers form an important contribution to the literature of electro-chemistry. We may mention here that through a printer's error, the abstracts of these papers printed in our issue of last week, appeared under a misleading head, through the substitution for the general title, "Electro-Chemistry," the title of one of the papers. There are at present two main groups of electro-chemical industries, namely, the electro-chemical and the electro-thermal. A few industrial processes are, however, intermediate, and form connecting links between these two divisions. While some few electro-chemical industries, such as electroplating, are nearly a century old, most of them are of very recent date. The modern industries require cheap electric power in nearly all cases, and, consequently, they naturally develop around waterfalls. No flat country like Holland can expect to foster large electro-chemical industries. Such industries naturally belong to countries of ups and downs. Two distinct fields of usefulness are developed in electro-chemical and electro-thermal industries. One is the production of already existing commercial chemical products, such as alkalis, aluminum and graphite, at reduced cost. The other is the production of new substances, or substances that cannot be obtained in any other way, such as carbides and silicides. Niagara Falls now produces both these classes of products.

A most interesting industry and one which may have important developments in its future, is the production of nitric acid from the atmosphere. It has long been known that the free oxygen and nitrogen of the air are capable of uniting at a sufficiently high temperature. Fortunately for all animal life, the temperature of their combination is very high, otherwise any spark, lightning flash, lighted tobacco pipe or conflagration might set the nitrogen of the air on fire and burn down the atmosphere. This is only another way of saying that the oxygen in the air has probably been produced from a pre-existing atmosphere of carbonic acid gas diluted with the nitrogen, by the accumulated activity of vegetation carried on through millions of years. On this view the carbon originally united with the oxygen in our atmosphere would make a layer of coal about 50 centimeters thick, all over the earth's surface, including ocean basins. By exposing dry air to a sufficiently high temperature obtained through the use of a number of arc lamps, the air is brought to the burning point at Niagara Falls, producing nitric acid, and thus nitrogen compounds, at apparently reduced cost. The presence of nitrogen as a constituent of plant tissues is necessary to animals who depend entirely upon plants for their nitrogen. Lightning flashes in the air and bacteria in the earth, living on the roots of plants, seem to be the only natural agents for restoring nitrogen to the soil after the plants or crops have been carried away. Any artificial method which can compete with bacteria from a commercial standpoint is capable of great development.

Taking up the several papers more specifically, it is interesting to notice that Professor Sheldon's paper mentions five organic substances that may be produced electrolytically. The paper of Mr. Jacobs, on the electric furnace in industrial chemistry, is mainly chemical, and it is interesting to see such papers read before the American Institute of Electrical Engineers. It describes the production of a number of substances, among them the silicides of barium, calcium and strontium. Calcium silicide when thrown into water has the convenient property of producing hydrogen; just as calcium carbide has of producing acetylene. One pounds of calcium silicide is stated to be capable of cooling 18.73 cu, ft. of hydrogen at standard temperature and pressure, or about one-tenth of its own weight of the gas. Barium silicide, possessing similar properties, is, however, recommended for this purpose. This electro-thermically prepared material may have a future field of usefulness in aeronautics, as, for example, in the filling of military balloons.

Dr. Keith's paper on the electrolytic recovery of copper from low-grade ores was confined to a consideration of the electrolytic treatment of a low-grade copper ore containing about 2 per cent of the metal. He alludes to 1½ per cent as being a minimum limit of richness at which it might be possible to extract metal profitably under otherwise favorable conditions. The process described is essentially one of crushing, roasting, leaching and electrolization, the copper being finally deposited on the cathodes in the electrolytic tanks. It is curious to notice that scientific metallurgical processes for the extraction of metals from their ores are tending to large operations on extensive deposits of regular low-grade ores, as distinguished from the work of the individual gold miner who only attempts to work with the cradle upon rich local deposits. The Rand in the Transvaal is a good example of the successful treatment of a large deposit of low-grade ore upon a large scale.

Mr. Carl Hering's paper on electrolytic conduction without electrodes, suggests a particular form of unipolar dynamo adapted to produce a unidirectional current in a tube of electrolyte closed upon itself, so as to form a purely electrolytic circuit without electrodes. It would be interesting to have such an apparatus constructed and tried; although it would be very remarkable if the e. m. f. in the circuit failed to produce electrolytic effects and ionic transfer. In fact, if it did fail to set up the expected electrolytic effects, it would be necessary to revise existing theories of electrolysis in order to call for an explanation. These theories, in the medium between the electrodes not in their immediate vicinity, prescribe actions due to the local electromotive intensity, and these actions should take place, whether there are electrodes or not, provided that the electromotive intensity is furnished.

The New York Central and Electric Traction.

An interesting "passage of arms" has occurred between Mayor Low and the New York Central Railroad in regard to the adoption of electric traction for the tunnel. The Mayor gave his indorsement to a bill seeking to set a date within which the company should abandon steam, whereupon eight of the directors of the road signed a letter to him, asking him to waive this point, pledging the company to change the motive power for suburban trains at the earliest possible moment. As to other traffic, however, the company's letter said: "If it were practicable to do this there would be no call for such legislation, for this company is as anxious as the public to operate all its trains through the tunnel by electric power. In the present stage of the electric art, however, we are advised that this is not practicable as to our heavy through trains, which carry distant as distinguished from local traffic. This part of the problem is made difficult by the exceptional and complex conditions prevailing at our terminal and by the very large scale upon which the traffic has to be carried on." This remark has set the electrical public wondering as to what it means, first as to what the advice was, and next who gave it; while another element of curiosity is as to the alleged difference in the tunnel of the two classes of traffic. So far as electrical engineers can see, the only difference is in the weight of the trains, and that is no obstacle, as the trains hauled electrically through the Baltimore tunnel are as heavy as anything the New York Central can show. The only well-known men whose names have come up in this connection are Messrs. F. J. Sprague and B. J. Arnold, and a well informed "Electrical Engineer," writing to the *New York Evening Post*, says:

"Irrespective of any general statements they may have made in the past, both of these engineers, and especially the latter, have recently given utterance to views which may be taken as defining their status and belief. Only two weeks ago they appeared before the Railway Committee at Albany and gave testimony for the railroad company upon this very question. Mr. Arnold's evidence was mainly about the time which would be required to get an electric system in operation, and he gave as his conclusion three years as a fair limit to put into a bill for the installation to be well under way. Mr. Sprague gave somewhat more extended testimony, and stated that in view of the character and size of the units which would be required, three years would be a fair limit for getting the suburban service into operation and making progress on the balance. In reply to questions by Mr. Wainwright, he specifically stated that in his opinion all the terminal service should be electrically operated, and that the central station units should be planned with regard to the necessities of entire electrical operation within a resonable distance from the Forty-second Street station. The same engineer, only a month ago, in a letter to a daily paper, in reply to one by Mr. Westinghouse, stated that every train movement at the Grand Central terminus could be effectively and safely made electrically, and that engineers were ready to contract to do it.

"In view of these facts it would appear distinctly improbable that these technical advisers have reported to the New York Central Railroad that the operation of all trains—that is, through as well as suburban—cannot be safely undertaken electrically, in so far as the city of New York has any concern. That concern is the operation of all trains within what may be called the "danger zone," not the operation only of suburban trains electrically, because, by a new arrangement of tracks requiring an underground tunnel, no other power is possible for them.

"There is one possible explanation of the statement in the Central's letter, which is, that they have been advised that the through, that is, long-distance electrical operation of their main trains, is not yet practicable."

It is to be added that Mayor Low this week has accepted the Apgar bill which fixes May 1, 1905, as the date when it shall become unlawful to use steam in the tunnel.

Electrical Engineers of the Day—XXXVII.

SAMUEL SHELDON.

Samuel Sheldon was born in Middlebury, Vt., March 8, 1862, and was fitted for college in the public schools of his native town. In 1883 he was graduated from Middlebury College, receiving the degree of B. A., and during the following academic year of 1884-85 he occupied the position of instructor in mathematics in that institution. A strong desire to acquire a more thorough theoretical knowledge of physics and electricity and a more accurate and systematic training in original research and investigation than could at that time be had in this country, prompted him to enter the University of Wuerzburg, Germany, where he spent the years 1885-87, as assistant in physics to the distinguished physicist Kohlrausch, and was associated with the latter in his celebrated determination of the ohm. At the conclusion of his work in the German University, in 1887, the degree of Ph.D. was conferred upon him. His old college at Middlebury, in recognition of his scientific attainments, honored him with the degree of A. M. in 1886. Returning to America he became assistant in physics at Harvard University, where he remained until the fall of 1889, when he was called to the chair of Physics and Electrical Engineering at the Polytechnic Institute, of Brooklyn, which position he still occupies.

Here an opportunity was afforded him to utilize the constructive and inventive faculties which had been strongly developed in his youth, namely, in creating and equipping a physical and engineering department and laboratory out of practically nothing. Many a creditable department has been developed, and many a spacious laboratory has been equipped in our modern colleges and schools under the beneficent wing of a generous endowment fund, but these were not the conditions under which Dr. Sheldon has worked for the past 12

years. With no available endowment and with only such funds as could be spared from the earnings of a self-supporting institution, he has, all things considered, inaugurated and developed one of the most creditable courses in electrical engineering, supplemented with laboratory and shop practice, to be found in any of our technical schools and colleges. What Dr. Sheldon lacked in apparatus and material equipment he made up for in originality of ideas and methods of presentation of facts to his students.

During his connection with the Polytechnic Institute, Dr. Sheldon has carried on an extensive practice as a consulting electrical engineer. His keen perception, accurate reasoning and clear and concise opinions inspire his clients and those who seek his advice with extreme confidence. He frequently is called upon to give expert testimony in State and Federal courts.

As a classroom teacher and demonstrator, Dr. Sheldon possesses those qualities which cause his listeners to be perfectly unmindful of the lapse of time. His humorous tendencies are well developed, while his powers of accurate description are manifested in the highest degree. As a contributor to the scientific and engineering press, Dr. Sheldon is widely known. His work on "Dynamo Electric Machinery" is his most notable production, and has been adopted in nearly all the leading technical schools and colleges of this country, as a standard text-book. A complete list of his scientific contributions would occupy more space than is here available, but they cover a multiplicity of subjects of great practical interest to the electrical engineer and student in applied science. He has been active and prominent for some years in the American Institute of Electrical Engineers, and is now a vice-president.

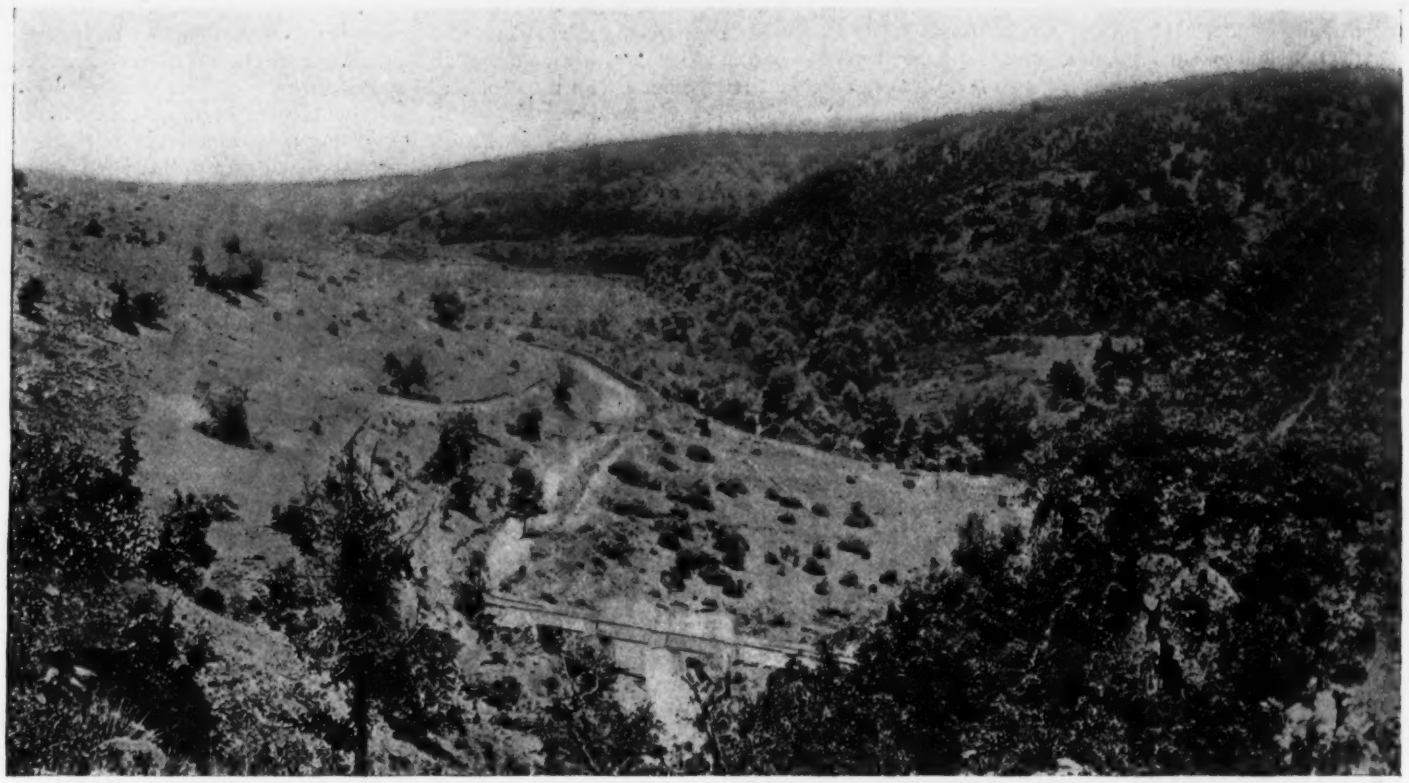


FIG. 8.—CANAL AND AQUEDUCT BETWEEN VILLADA AND FERNANDEZ LEAL.

The Transmission System of the Compania Explotadora De San Ildefonso of the City of Mexico—I.

BY STEPHEN Q. HAYES.

THE Compania Explotadora de San Ildefonso operates a remarkable transmission system, supplying current for lighting and power purposes to the City of Mexico. The most striking fact about this transmission system is that the usual arrangement of a single generating station furnishing power to a number of sub-stations is here reversed, and a number of generating stations supply power to a single sub-station.

Along the banks of two mountain streams, the Monte Alto and the Tlalnepantla, that tumble down the eastern slopes of the Mexican Sierras, just without the City of Mexico, are installed a number of small generating plants at various points. The streams rise in the mountains, closing at the west the Valley of Mexico, and flow side by side in a westerly direction, one of them finally turning to the north and the second toward the northeast, as shown on the map (Fig. 1). On the Monte Alto are two power stations, one at Villada, and one at Fernandez Leal. On the Tlalnepantla are three, Alameda, Chiluca, Madin. The nearest is 10 miles from the receiving station at La Veronica in the suburbs of the City of Mexico.

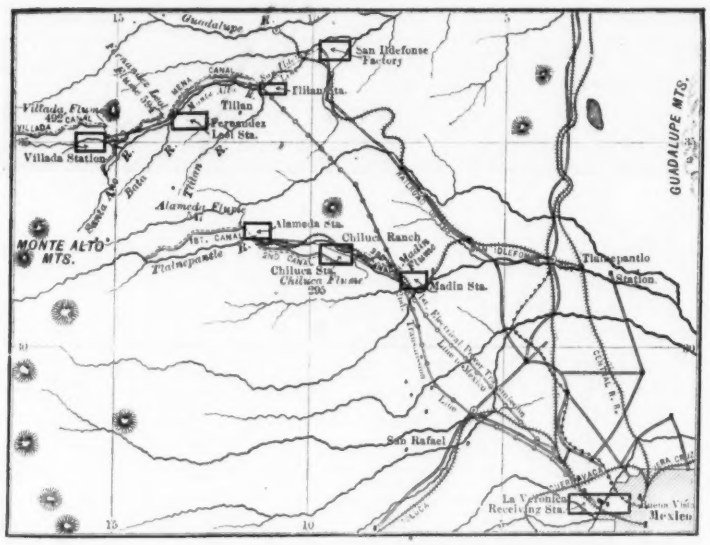


FIG. 1.—MAP OF THE VALLEY OF MEXICO.

This peculiar arrangement of stations is the result of a successful plan to utilize the natural fall of water along each of the rivers, by placing the generating stations at those points where the water power is most available, and the arrangement has given rise to a number of novel problems in high voltage transmission work. These have been successfully met, and their solutions present many interesting features, to be described later in detail.

In the rough, mountainous country here existing it is no easy undertaking to carry a water supply to the various power stations, when the waterways, as projected, are of considerable length—2 to 8 miles—and must at times cross ravines, pierce hillocks, but still follow the generally uneven and deviating slope of the ground. For the greater part of their length they are canals dug in a volcanic tufa so hard that, in several places where it was pierced by tunneling, no lining was needed to prevent leakage. Of course, the volcanic surface is not everywhere uniform. At a few points it is a pudding-stone of such porosity as to require a lining to make it water-tight. The upper part of the Villada Canal is in a clayey soil, and the sides are retained by a wall of masonry.

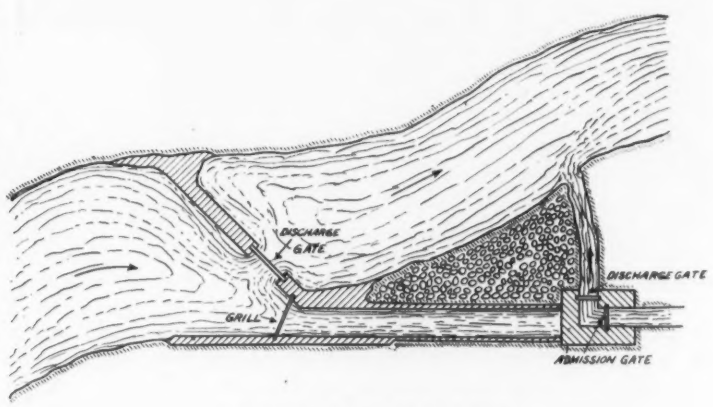


FIG. 2.—LOCATION OF THE DAM.

The engineering difficulties encountered in the construction work were numerous. Across small ravines aqueducts were built of masonry supported by I-beams arranged in pairs and resting upon pillars either of stone or substantial ironwork, an arch of corrugated sheet iron from one inside I-beam to another supporting the bed of

the waterway. The most noteworthy bit of construction work was the crossing of a tributary valley of the Rio Alto, too wide for an aqueduct, by a large siphon tube of steel. This is inverted in position and dipping into the valley reaches from one canal to another. It is 750 ft. long and 200 ft. deep, and is shown in Fig. 9. The piping is supported on a substantial masonry bridge and anchored at either end in blocks of masonry. The water descends to the power stations through a steel pipe almost 4 ft. in diameter. Several views show this piping, or flume, lying on the rough, uneven hillside. Wherever the piping takes a bend it is, of course, anchored in blocks of masonry.

The Villada Canal begins at a dam across the Monte Alto high up in the mountains. The mouth of the canal is protected by a strong grill against the entrance at flood tide of tree trunks and other debris. A second grill of finer mesh picks up any floating objects that may have passed the first one. After winding for several miles through a country, the uneveness of which is well shown in Fig. 8, the Villada Canal comes to the brow of a steep hill above the power station (Fig. 6). A settling reservoir of generous dimensions receives the water, and communicates by a canal with a second storage reservoir from which the flume passes down the hill to the power station. Leaving the Villada power house, the canal empties into the river, some feet above the dam intended to turn the water into the next canal, which feeds the Fernandez Leal power house, five miles below Villada. This canal, after meandering down the easiest slope, finally opens upon a little plateau, where the construction of a settling basin and water reservoir presented little difficulty.

FIG. 3.—PIPE LINE TO ALAMEDA STATION.

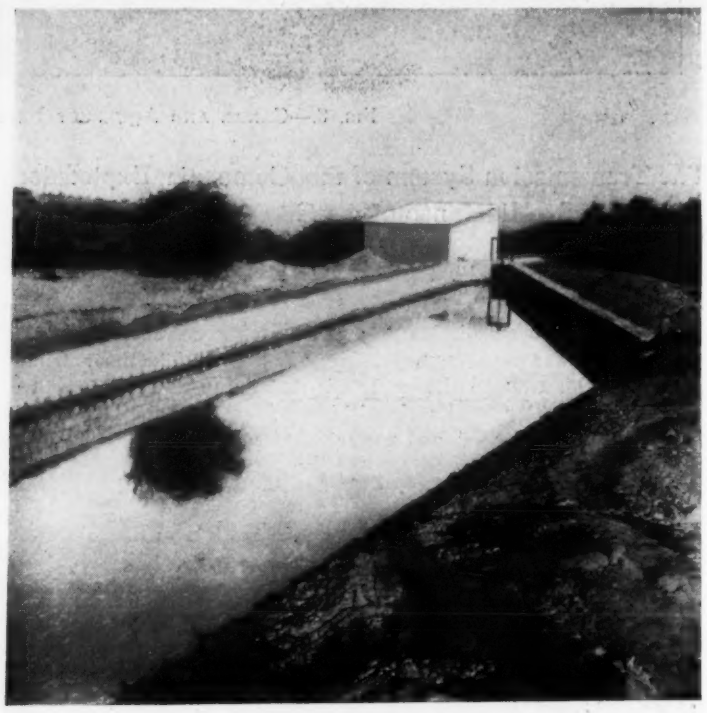


FIG. 4.—TANK AT ALAMEDA.

Along the Tlalnepantla River are canals of much the same general character as those along the Monte Alto. Fig. 4 shows the basin at the top of the Alameda Hill. It also gives a good idea of the volcanic pudding-stone in which a part of the waterway system lies.

As all of the water powers are comparatively small, it was impossible to install at any one point a plant large enough to furnish the required amount of power. Moreover, owing to the distance between the points of maximum fall along the streams, it was better and cheaper to install a generating plant at each one, using a number of small generators (225 kw each), rather than to build a canal long enough to use the entire hydraulic head at one point, although the latter plan presented the possibility of using a few large generators rather than the 19 small ones which go to make up a total of 4225 kw comprising the present installation.

Not the least of the advantages to be gained by the use of these small generators is the facility with which they can be transported in a rather wild and mountainous district. Of scarcely less importance than the consideration of portability, is that of immunity from shut downs. This could easily be secured by making all of the machines of the same capacity, so that a fewer number of repair parts would insure against the shutting down of a plant, so far from the factory where the machinery is built. This idea has been closely followed out in the entire installation. The generators and raising transformers are all of the same capacity—225 kw. The various switchboard panels are, as far as possible, duplicates of each other, and may, if desired, be used at any of the generating stations, and not necessarily at the one for which they were originally built. Extra fuses and similar parts liable to be destroyed are kept in stock in the City of Mexico, so that it is not necessary to send to the builders of the original equipment, the Westinghouse Company, at Pittsburg, for repair parts.

GENERATING STATIONS.

Fig. 11 shows the general arrangement of the various stations with respect to each other, and is what may be called a "single-wire diagram" of this polyphase installation. Each circuit, whether consisting of two, three or four wires, is shown as a single line, and only the general layout of the various apparatus appears, all other details being omitted to avoid confusion. The interesting points about the layout are more clearly indicated in some of the later diagrams, which show details and practically all of the connections at the important points.

As previously stated, along the Monte Alto River there are two generating stations at Villada and Fernandez Leal; on the Tlalnepantla River three generating stations at La Alameda, Chiluca and Madin. In Fig. 11 the number of generators in each station is indicated by circles marked *G*, and the banks of raising transformers are shown by circles marked *T*.

In all of these five stations the generators are 225-kw, Westinghouse two-phase alternators, delivering 280 amperes per terminal at 440 volts, and 50 cycles. They are all direct connected to Piccard and Pictet waterwheels running at 430 r. p. m.

On page 468 is a brief synopsis of the apparatus at each station, beginning with the station of largest output.

There are 19 generators with an aggregate output of 4225 kw; 22 raising transformers with a total capacity of 4950 kw, and 10 exciters of an output a little less than 200 kw, making a total of nearly 10,000 kw in generating and transforming machinery.

At first sight it may seem odd to have 4950 kw installed in transformers and only 4225 kw in generators, but it must be borne in mind that the generators are installed in units of 225 kw each, while trans-

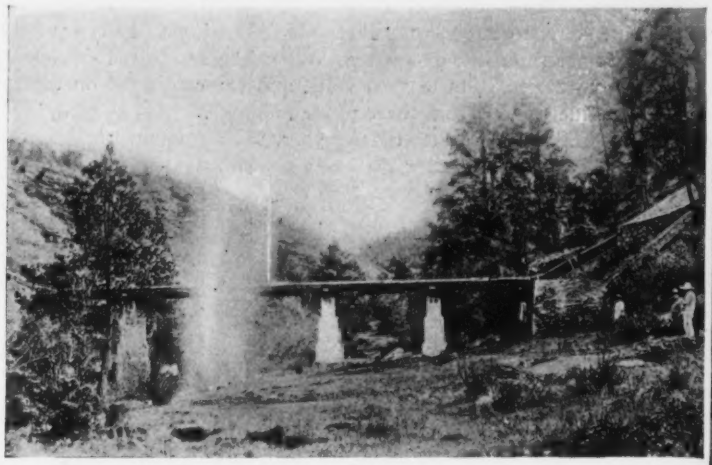


FIG. 9.—INVERTED SIPHON ON MONTE ALTO LINE.

FIG. 5.—VIEW OF ALAMEDA FROM TANK.

FIG. 10.—EXTERIOR OF ALAMEDA POWER HOUSE.

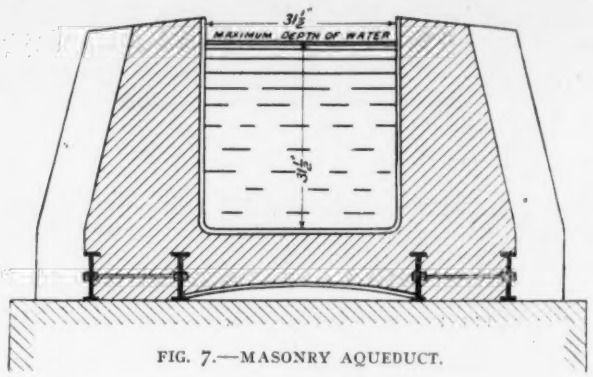


FIG. 7.—MASONRY AQUEDUCT.

FIG. 6.—EXTERIOR OF VILLADA STATION.

formers are grouped for transforming from two-phase to three-phase with an output of 450 kw for each pair.

While speaking of this ratio of the generator output to the transformer output, it would be well to compare the generator capacity with the exciter capacity. The exciters in each station have about 4 per cent of the output of all the generators. As alternating-current generators of this size require approximately but 2 per cent of their

VILLADA.

5	225-	kw,	440-volt	generators.
6	225-	kw, 440-22,000	"	raising transformers.
2	22½-	kw, 125	"	exciters.

FERNANDEZ LEAL.

Same as Villada.

LA ALAMEDA.

4	225-	kw,	440-volt	generators.
4	225-	kw, 440-22,000	"	raising transformers.
2	22½-	kw, 125	"	exciters.

CHILUCA.

3	225-	kw,	440-volt	generators.
4	225-	kw, 440-22,000	"	raising transformers.
2	15-	kw, 125	"	exciters.

MADIN.

2	225-	kw,	440-volt	generators.
2	225-	kw, 440-22,000	"	raising transformers.
2	11¼-	kw, 125	"	exciters.

output for field excitation, it will be seen that in each station one exciter is capable of taking care of the field currents of all the machines, the second exciter being held in reserve.

By referring again to the diagram (Fig. 11) it will be noticed that

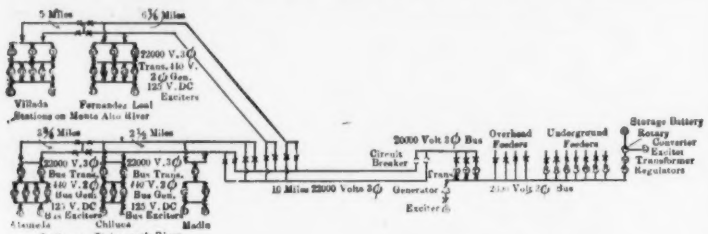


FIG. 11.—GENERAL DIAGRAM OF SYSTEM.

the 22,000-volt lines from the raising transformers in the stations along the Monte Alto River can be thrown on either or both of two sets of transmission lines running to Madin, and similarly, that the stations along the Tlalnepantla River can be connected to either or both of the two lines along that river. At Madin these four transmission lines come to one high-tension switchboard (Fig. 12), where they can be connected to either or both of two three-phase, 20,000-volt lines leading from Madin to the City of Mexico. The duplica-

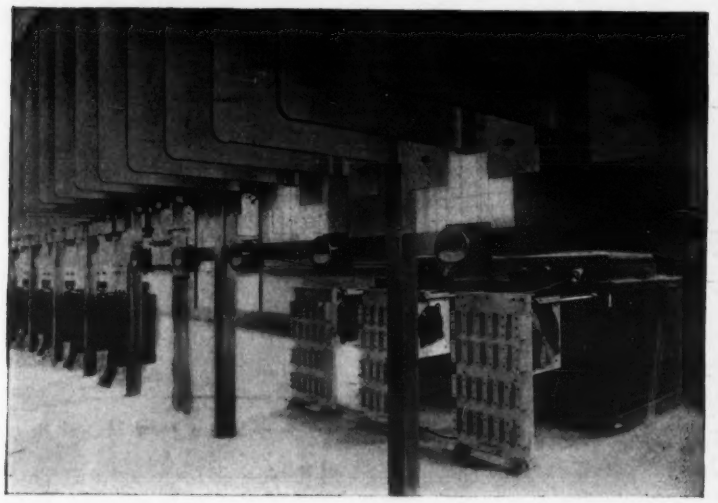


FIG. 12.—HIGH-TENSION ROOM AT MADIN.

tion of these transmission lines allows any one to be disconnected for inspection or repair without shutting down the plant.

On their arrival at the La Veronica receiving station, the lines pass through two three-pole, 20,000-volt, 150-ampere reverse-current circuit breakers, to 20,000-volt, three-phase bus-bars. Fed from these bus-bars are three sets of lowering transformers that reduce the pressure from 20,000 volts to 2600 volts, and are connected on the low-tension side to 2600-volt, three-phase bus-bars.

During the dry season of the year, lasting about 100 days, the amount of available water power is not sufficient to supply the de-

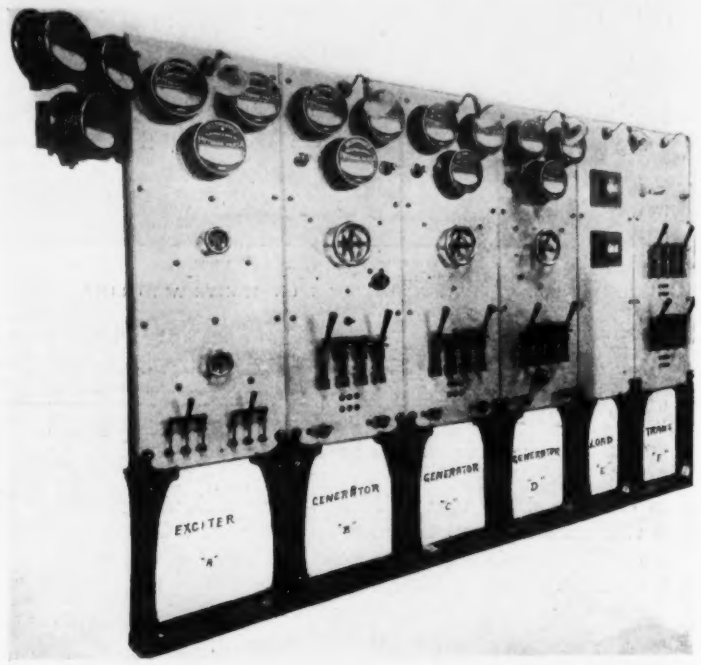


FIG. 13.—FRONT VIEW OF CHILUCA SWITCHBOARD.

mands of this distributing station, and, therefore, a 375-kw, 2600-volt, three-phase, 50-cycle, steam-driven generator has been installed. Provision has been made for two more steam-driven units to run in multiple on the same bus-bars as the lowering transformers. In other words, they are run in synchronism with 19 waterwheel-driven generators, the nearest being 10 miles away and the farthest 22. The generator now in place is attached by a flexible coupling to a steam engine running at 177 r. p. m., normal rating 500 hp, maximum rating 700 hp. Four Babcock-Wilcox boilers furnish steam at 140 lbs. pressure. A storage battery, rotary converter and lowering transformers for the rotary are also installed in this station.

During the period of heavy load the battery helps out by discharging into the rotary, which converts the direct current thus supplied to an alternating one and feeds back through its transformers to the

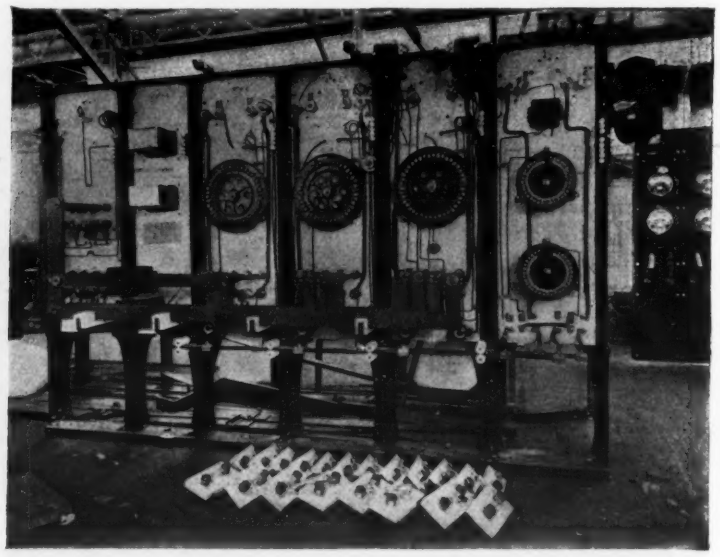


FIG. 14.—REAR VIEW OF CHILUCA SWITCHBOARD.

three bus-bars and out over the three-phase feeders. This rotary is, of course, in multiple with all of the other apparatus of the system.

The switchboards of the system were installed in 1898, and have been in continuous service for the last three years, and have given

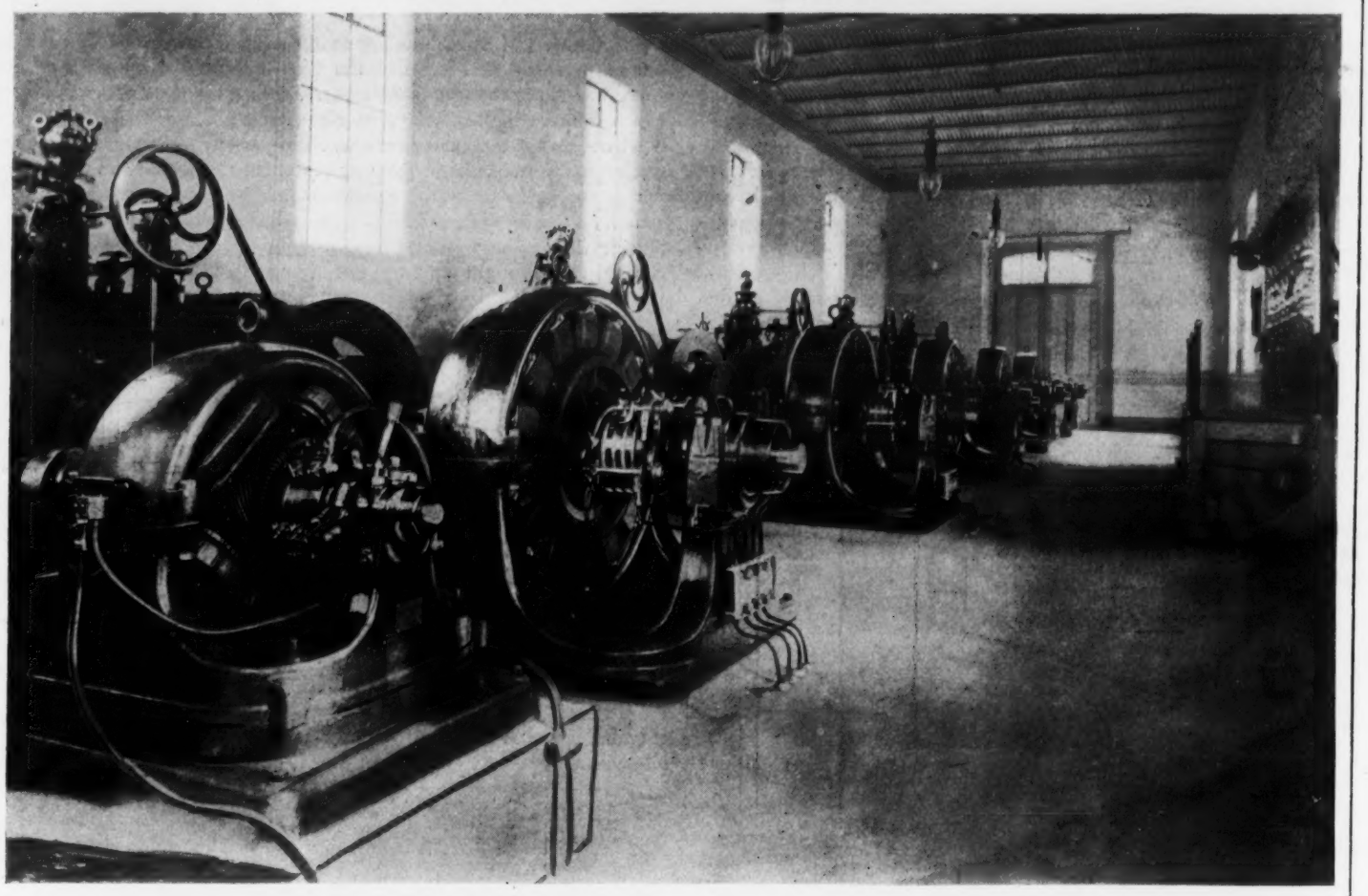


FIG. 18.—INTERIOR OF VILLADA STATION.

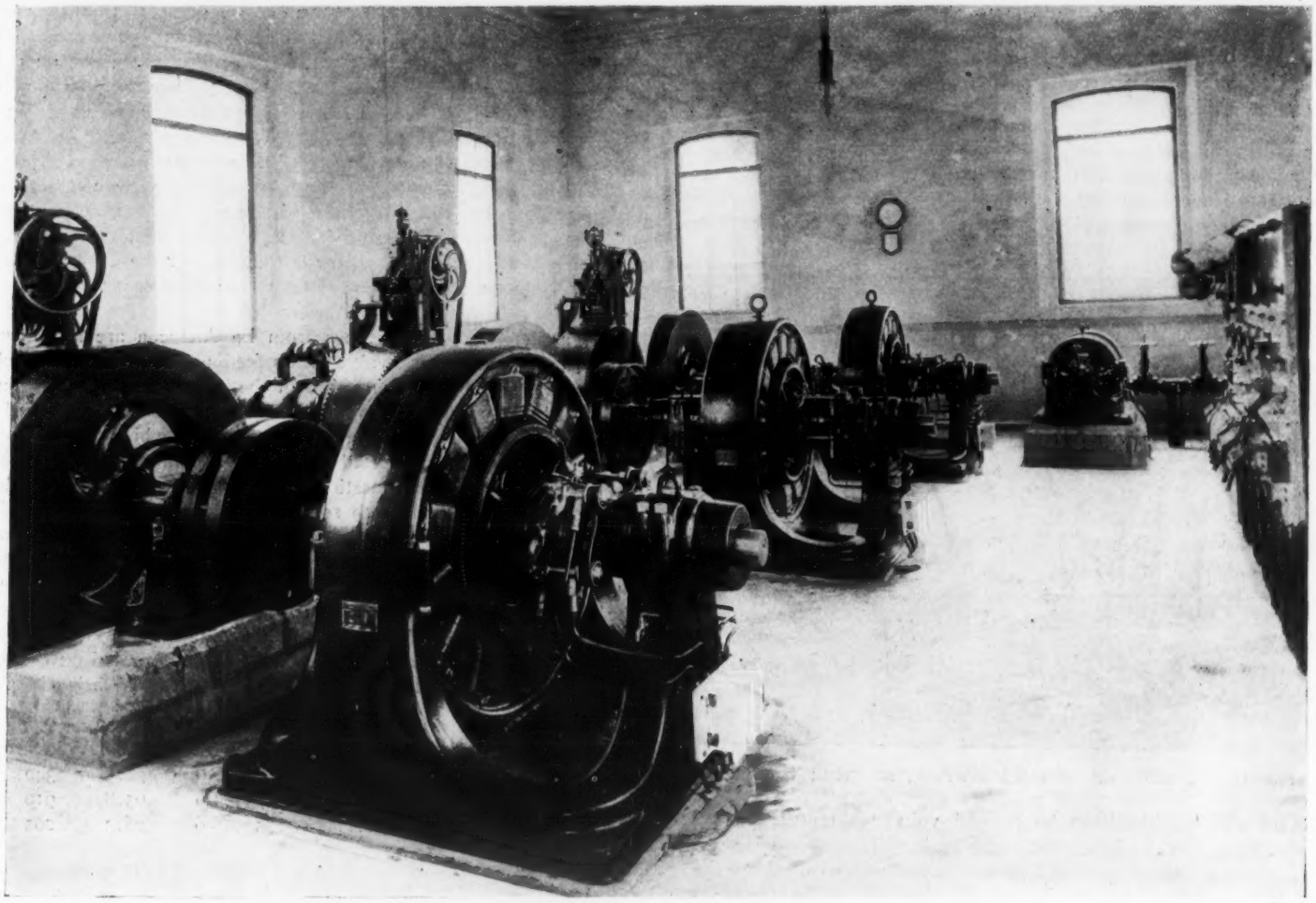


FIG. 15.—INTERIOR OF CHILUCA STATION, SHOWING GENERATORS.

entire satisfaction. As the switchboards are nearly identical—for they were built with the idea of having the panels duplicates of each other as far as possible—the plant at Chiluca, which is typical of the others, will be described, and afterwards it will be pointed out in what respects the others differ from this one.

Fig. 13 shows the front and Fig. 14 the rear of the low-tension switchboard installed in the Chiluca generating station. Fig. 15 and Fig. 16 show the interior of the station. At Chiluca two 15-kw, 125-volt exciters are controlled by panel *A*, the one on the extreme left-hand end; three 225-kw, 440-volt generators are controlled by panels *B*, *C* and *D*. There is a load panel *E*, and two banks for raising transformers, each consisting of two 225-kw transformers, are controlled by two four-pole switches on panel *F*, the one on the extreme right.

Figs. 13 and 14 show very clearly the type of switchboards, the number of instruments, etc. As the wiring diagram indicated the connections of all these instruments, it is unnecessary to go into details concerning this switchboard. There are a few points, however, which might be noticed with some particularity.

On the load panel are mounted one pilot lamp and two 1500-ampere, 450-volt, Niagara type indicating wattmeters. These meters have their current coils fed from the secondaries of 1500 5-ampere series transformers placed over the main bus-bars (See Fig. 14), and which have their voltage coils connected directly to the same bars. These two meters indicate the total output of the station, and if during light load, i. e., with only one machine running, that machine should tend to run as a motor fed from the line, these wattmeters would immediately indicate the trouble by running backwards. Another advantage of these indicating wattmeters is that a comparison of their readings with the result obtained by multiplying the sum of the ammeter readings by the voltmeter reading, which gives the apparent output, will give the power factor of the system.

This power factor depends, among other things, on the field excitation of the machine, and for a given load the other conditions being constant, there is one definite field charge that will give the highest power factor. By adjusting the field rheostat and watching the main alternating-current ammeters, a point will be found where, for a given output, the reading of these ammeters will be a minimum and consequently the power factor of the generator a maximum. This proper field current will be indicated on the direct-current field ammeter, and afterwards the station attendant will know that for a given output a particular field current will give the best results and can set his rheostat accordingly.

On the feeder panel the outfit comprises one pilot lamp, two synchronizing lamps and plugs, with two six-point voltmeter receptacles and two four-pole, quick-break, 600-ampere switches. As the function of the synchronizing lamps and voltmeter receptacles on a feeder panel may not be apparent at once, it will be necessary to refer to Fig. 17, which shows the diagram of connections of the Chiluca generating station in greater detail than shown in Fig. 11.

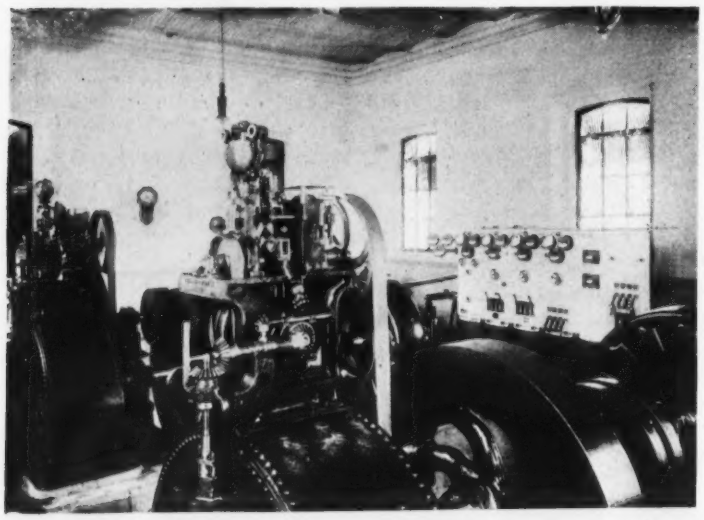
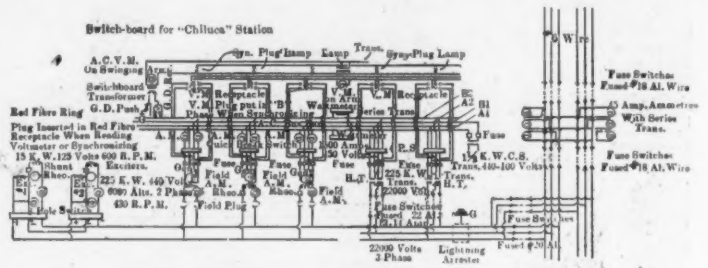


FIG. 16.—INTERIOR OF CHILUCA STATION, SHOWING TURBINES.

Let us suppose that the 22,000-volt transmission lines passing the Chiluca station were alive, i. e., that the plant at La Alameda was running. Before the Chiluca plant can be thrown in multiple with it, it is necessary to synchronize the plant as a whole with the transmission line. This is done by first closing the high-tension fused circuit breakers that connect the line with the 22,000-volt, three-phase bus-bars from the transformers, then close the circuit breakers which cannect one bank, say, the right-hand one, to these three-phase bus-bars, and the transformers will then act as lowering transformers, reducing the voltage from 22,000 volts, three-phase to 440 volts, two-phase. If none of the generators has been started the four-pole switch on the low-tension side of the transformers can be closed, thus placing the bus-bars in synchronism with the line and the generators can then be brought up to speed separately and synchronized with the bus-bars.

If, however, some of the machines are already connected to the bus-bars, then it is necessary to put the ground detector plug in the


Switch-board for "Chiluca" Station
Syn. Plug Lamp
Lamp
Trans.
Spare Plug Lamp
A.C.V.M.
On Swinging Arm
Switchboard Transformer
G.D. Push
Red Fibre Ring
Plug Inserted in Red Fibre Receptacle When Reading Voltmeter or Synchronizing
15 K.W. 125 Volts 600 R.P.M. Shunt Exciters.
225 K.W. 440 Volts 6900 Alt. 2 Phase 450 R.P.M.
Field Plug
Fuse
Field
A.M.
Rheo.
Field
A.-M.
Fuse
Field
A.M.
Rheo.
Field
A.-M.
Fuse
30 Volts
225 K.W. 2200 Volts
Trans.
Fuse
Fuse Switches
Fused 22 Al.
Fuse
Fuse
Fuse

practicable to bring out loops for these exact drops and still have the transformers interchangeable, these voltages were approximated to and the exact voltage obtained by slightly altering the primary voltage (that of the station bus-bars) by field regulation.

To return again to the low-tension part of this diagram, there is one point to which it will be well to call particular attention as a procedure opposed to Westinghouse standard practice, but put in at customers' request—supplying fuses for the connection between the generators and the alternating-current bus-bars.

The objection to the use of fuses between alternators and bus-bars is that they are not needed for the protection of the machine, and that they are liable to blow at a most inconvenient time—the moment of synchronization. The Westinghouse alternators are built with such armature reaction that even on a dead short circuit they will not generate sufficient current to damage themselves, and for this reason, fuses or other automatic protection are not needed. Moreover, at the instant of synchronizing, if the two machines are not exactly in phase when thrown together, there may be a rather heavy interchange of current from the leading to the lagging machine, which will immediately pull the two machines into step without damage to either, unless the circuit is opened by the blowing of a fuse. Therefore, the use of fuses at this point is unnecessary, but as stated before, they were installed at the customers' request. The remainder of the low-tension diagram will readily be understood.

The installation at Madin differs from that at Chiluca in having only two generating panels, and in having exciter ammeters and load wattmeters of smaller capacity; but it has in addition panels for the line wattmeters. That at La Alameda has one more generator panel and larger exciter ammeters and load wattmeters. The Villada station, shown in Fig. 18, and Fernandez Leal, which are duplicates of each other, are provided with five generator panels, larger exciter ammeters and load wattmeters than Chiluca, and an additional bank of raising transformers controlled by a four-pole switch, placed on the load panel below the wattmeters.

Single-Phase Permutator with Revolving Brushes.

BY P. LETHEULE.

MM. ROUGE AND FAZET have designed an interesting apparatus for the purpose of charging automobile storage batteries from a single-phase distributing system, which may be considered to be a combination of the well-known principles of the single-phase converter with the principle of a new class of rectifiers, which may be termed reaction rectifiers. Their fundamental principle is as follows:

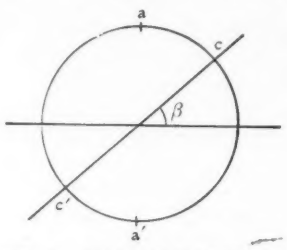


FIG. 1.—DIAGRAM ILLUSTRATING PRINCIPLE.

Let us consider a two-pole Gramme ring armature, provided with a commutator and placed in a magnetic medium permitting an equally good flux path in all directions. Assuming an alternating difference of potential to be applied between commutator segments a and a' (Fig. 1), then

$$E = E_A \sin \omega t$$

The value of the difference of potential between two diametrically opposed segments, c, c', corresponding to a given value of angle β is known to be

$$e = E \sin \beta$$

If we now assume two brushes revolving on the commutator surface with synchronous speed, and so adjusted that β exactly equals ωt, then

$$e = E_A \sin^2 \omega t = \tfrac{1}{2} E_A (1 \cos 2\omega t).$$

The no-load difference of potential thus appears as the superposition of a constant potential difference of $\frac{1}{2} E_A$, and of an alternating potential difference $\frac{1}{2} E_A \cos 2\omega t$; that is, a frequency of 2ω and an amplitude of $\frac{1}{2} E_A$.

The working conditions under load may be determined, according to the nature of the receiving circuit, by application of the usual formulas to the alternating component, taking account of the inductance of the system.

A permutator of this class recently exhibited at the Grand Palais du Champs Elysees by MM. Rouge and Fazet, and shown in Fig. 2, was designed and built as follows. The external part consists of a fixed four-pole ring armature, series wound, with 45 coils of 10 turns each, laid in slots on the outside periphery of the ring (Fig. 3), the inside periphery of the same ring being used for closing the magnetic circuit of the reaction rectifier.

Inside the commutator ring is a steel inductor running synchronously, which is shaped like a Gramme ring for the purpose of offering to magnetic leakage a permeability equal in all directions (Fig. 3). Being moved directly by a derivation of the main flux, this ring can revolve the brushes at a constant phase angle, since it does not depend on the interposition of any m. m. f. due either to the alternating or the direct current of the machine.

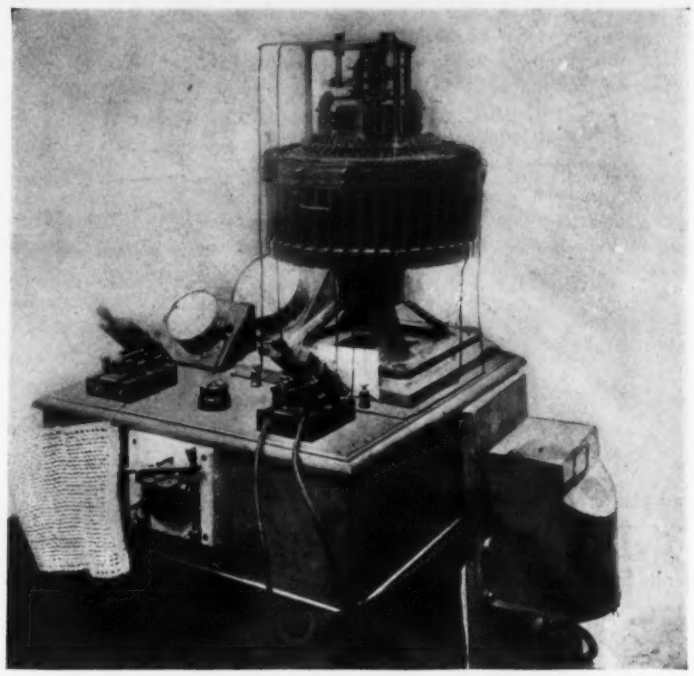


FIG. 2.—30-AMPERE, 90-VOLT SINGLE-PHASE PERMUTATOR.

For the purpose of starting as well as improving the rectifying actions of the transformer, the inventors connect (Fig. 5) two conveniently placed points of the armature, C E, by means of a non-inductive resistance, D, the single-phase terminals being A and B.

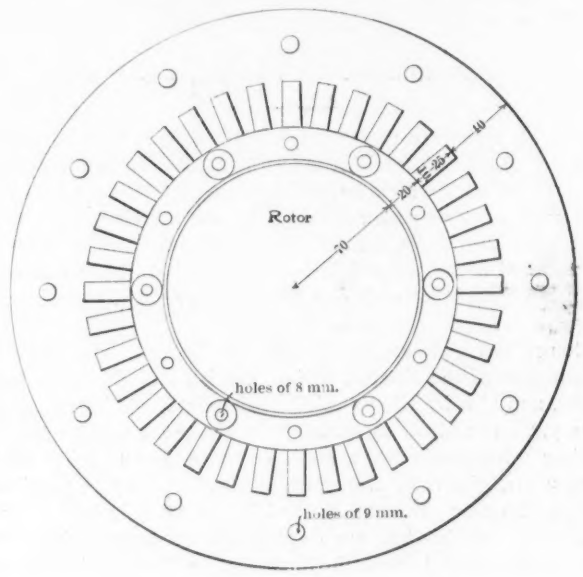


FIG. 3.—DETAILS OF PERMUTATOR.

This produces a sort of revolving field, which, although very imperfect, yet is sufficient to enable the dead points to be passed by the moving part. If the field of the machine were a regular revolving field, there would always be a value of the angle of brushes allowing a commutation to be obtained. With a single alternating field equivalent, according to Fresnel's law, to two magnetic component fields revolving in opposite directions, it was to be feared that the component field of opposite directions with regard to the rotation of

brushes might produce an objectionable sparking. Tests, however, have shown that, at least running light, a perfect commutation can be obtained without any sparking. For running equally well under

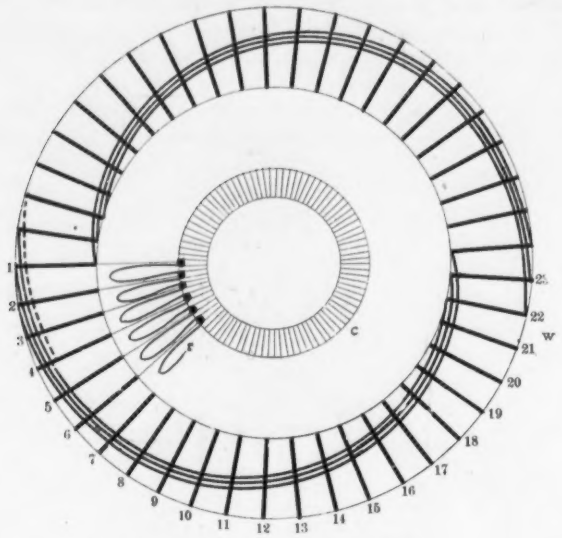


FIG. 4.—SCHEME OF WINDING.

load the inventors have designed an ingenious way of decomposing the commutations into two distinct operations.

As every pole has two sets of brushes running in multiple, each set is alternately used for carrying the largest part of the current, the other set being used for commutating; that is, for changing the coil. This result is obtained as shown in Fig. 2.

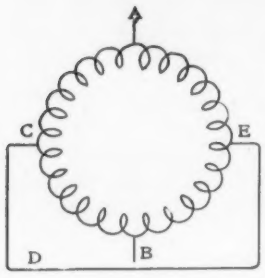


FIG. 5.—CONNECTIONS TO WINDING.

The commutator of the machine now practically used consists of 90 segments, corresponding to a 45-coil armature; but instead of being all direct connected to the windings, every second segment of the commutator has a direct connection to the winding, the remaining segments being connected to the preceding ones relatively to the direction of rotation of brushes by means of a resistance *r* of a high value. (Fig. 4.) In this illustration *w* represents the end connections of the windings, *c* the commutator and *r* the resistance.

Automobilism in England.

Automobile clubs are now established all over the United Kingdom, mostly in affiliation with the Central Automobile Club of Great Britain and Ireland, which is now agitating for the removal of the restrictions placed on motor vehicles by the act of 1896, which removed earlier absurd regulations, such as that no mechanical vehicle should proceed along the public road at a speed of more than four miles an hour, and that each one must be preceded by a man with a red flag.

In a long letter addressed to the press and signed by the presidents of the councils of the French, Swiss, Belgian and Austrian automobile clubs, and also by all the chief British automobilists, cogent reasons are put forward for an amendment of the act which prevents an automobile being worked at a speed of more than 12 miles an hour, even on a straight road free from traffic. The protest points out that the systematic prosecutions and heavy fines imposed for constant breaches of this law are damaging an industry whose importance can be inferred from the fact that in October last, probably the quietest month in the year, $227,205 left the country for France, Germany and the United States for the purchase of automobiles.

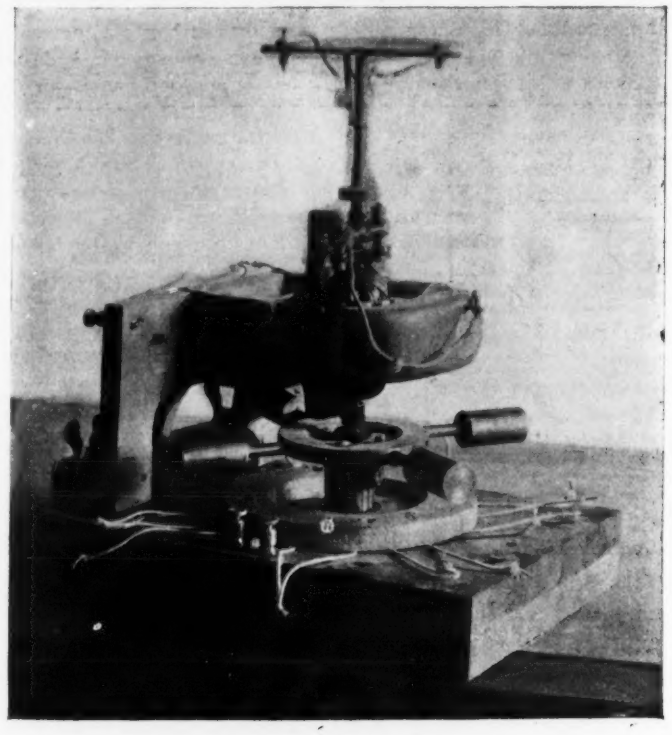
English manufacturers are also protesting against these restrictions, which, they say, hamper the automobile manufacturing industry at the present time, owing to the prejudice against automobiles, the systematic prosecutions and the heavy fines imposed for breaches of the 12-mile-an-hour limit, thus damaging an industry which is encouraged in almost every other country, so that a source of employment for thousands of men is checked, and English automobilists are still ordering, to a great extent, machines from abroad.

A Device for Synchronizing Motors.

BY PROF. WILLIAM DUANE.

IN certain kinds of multiplex and printing telegraphs and in the picture telegraph, it is necessary to have two brushes, type wheels or drums, at each of two stations, revolving synchronously. The purpose of the device described below is to synchronize two electric motors under the following conditions: Firstly, there shall be but two wires, or one wire and earth return between the two stations. Secondly, this circuit shall be utilized for synchronizing purposes during a small fraction only of the time required for each revolution of the motors. Thirdly, the power transmitted over the line shall be very small compared with the power required to drive the motors. The scheme for synchronizing the motors may be divided into two parts—a regulator for each motor, by which it can be made to run at any desired speed, and by which this speed is kept practically constant; and a device by which when the motors are running at nearly the same rate, the speed of one or both of them is automatically varied so as to keep them always synchronized with each other.

The regulating device may be understood from the accompanying illustration, which is reproduced from a photograph of a machine constructed for experimental purposes. The motor is suspended in such



SYNCHRONIZING DEVICE.

a way that the axis of its armature is vertical. The lower end of the axle is sharpened, and rests upon a steel plate just below the flywheel, but not seen in the picture. This is to furnish a firm support and a bearing with very little friction for the rotating parts. The motor's commutator is just above the armature. The axle above the commutator is hollow. Two insulated wires are soldered to two opposite segments of the commutator, and pass up through the hollow axle and out at a hole near the top. The hole is on the far side of the axle and not seen in the illustration. One of these wires is carried to the outer left-hand end of the cross bar (which is non-conducting) and soldered to a nut firmly fastened there. In this nut turns a thumbscrew, which carries a platinum point at its lower end. The other wire is soldered to a metal pin passed horizontally through the cross bar near the axle. The pin passes through a hole in the upper end of a movable conducting arm seen in the illustration hanging down near the axle. The arm carries a weight two-thirds of its length from the top, and at its end a small platinum plate.

When the armature revolves, owing to the centrifugal force the arm swings outward, and if a sufficient speed is reached, brings the platinum plate into contact with the platinum tip of the thumbscrew. This short circuits the armature and prevents further increase of speed. If the speed decreases, the platinum plate falls away from the thumbscrew and breaks the short circuit. Thus a speed is maintained

which is just about sufficient to bring the plate into contact with the point. The speed of the motor can be varied by screwing the thumb-screw up or down. Two wires similar to those described above are seen in the illustration running to a pin and nut at the other end of the cross bar, and a second short-circuiting arm could be used on this side, too. This double short circuit, however, was found to be superfluous. The motor represented was originally designed as a small series-wound electro-plating dynamo, and when running as a motor the armature revolves in the clock-wise direction, as seen from above.

The speed of this machine remains constant to within one part in 200; further, if stopped, left for a while, and started again on some future day, it will run with the same speed as before to within one part in 200, provided no very large change is made in the e. m. f. or resistance of the motor circuit. A large change in either of these quantities, however, will alter the speed slightly. For instance, an increase in the current supplied the motor from .8 to 1.4 amperes, increases the speed by about 2 per cent. The fact that this change in speed takes place is due probably to the jarring of the platinum contact. There is very little or no sparking when the contact is broken, and it does not appear to be necessary to keep the platinum surfaces clean. As a matter of fact, these particular pieces of platinum have not been cleaned since the machine was constructed.

The synchronizing device is as follows: Two motors similar to that represented are placed at the two stations, respectively, and regulated to run at approximately the same speed. The axle of each motor is joined to the line wire by means of a metal rod passed up through the center of a fixed commutator seen in the illustration just below the flywheel. One end of this rod is soldered to the steel-bearing plate upon which the axle rests, and the other is connected by a wire with one of the small binding posts on the wooden base of the machine and thence to the line. In this line circuit is inserted a battery of sufficient strength to work a high-resistance relay. A metal brush fastened to the flywheel revolves with it, and touches in succession the insulated segments of the fixed commutator.

Let us call one of the motors *A* and the other *B*. One segment of *A*'s fixed commutator is divided into two halves insulated from each other. One-half of the corresponding segment of *B*'s commutator is cut away and the space filled by insulating matter. Let *a* be the half of the divided segment that *A*'s brush touches first in its revolution, and *a'* the second half, and let *b* be the corresponding segment in *B*'s commutator. The segment *b* is connected directly to the earth or the return wire, and *a* and *a'* are connected through two coils of a double relay, respectively, to the earth or the same return wire. This double relay is so constructed and joined up that a current from *a* through the coil joined to it pulls a small lever arm over and short circuits part of the resistance of *A*'s motor circuit, and a current from *a'* through its coil pulls the same lever arm back again, breaking the short circuit. Suppose that *A* has been regulated so as to run slightly slower than *B*. If they are started running, *A* gradually falls behind *B* until, when *B*'s brush touches *b*, *A*'s brush touches *a*. This completes the circuit through *a*'s coil of the relay, the lever arm is drawn over and the portion of *A*'s motor circuit is short circuited. *A*'s speed then increases as explained above, and *A* gradually gains on *B* until when *B*'s brush touches *b*, *A*'s brush touches *a'*. This completes the circuit through *a''*s coil of the relay, the lever arm is pulled back and the short circuit broken. *A* is now running slightly slower than *B*, and the above process is repeated. This keeps the motors running nearly in phase with each other. One motor will gain on the other slightly and then fall behind, but in the case actually tried the difference in phase did not exceed one-fiftieth of a complete revolution.

The advantages of this method of synchronizing motors are that, as stated above, a very small current sent over the wire, namely, enough to work a sensitive relay, is sufficient to maintain synchronism, and since the wires are used for this purpose during a small part of the time only, they may be used for telegraphing almost all the time. Further, if one of the motors is stopped for any reason and started again, they will get into synchronism automatically, and will run together in only one relative position with regard to each other; i. e., so that when *B*'s brush is on segment *b* *A*'s brush is on segments *a*, *a'*.

The commutator in the machine represented in the picture was designed for multiplex telegraphy. It has 18 segments in addition to that used for the synchronizing device. A key placed in a circuit joining any of these segments to the earth or return wire, will operate a relay similarly placed in a circuit connecting the corresponding segment in the other machine with the same return. In this way 18 distinct circuits have been operated simultaneously over a single wire and return, running the length of the university campus, and containing a resistance of 500 ohms. Only one battery was required to operate these 18 circuits and the synchronizing device. Whether the above described scheme will work over a very long line or not remains still to be investigated.

HALE PHYSICAL LABORATORY, UNIVERSITY OF COLORADO.

On the Elevation of the Electrically-Conducting Strata of the Earth's Atmosphere.

BY A. E. KENNELLY.

ACCORDING to the measurements of Professor J. J. Thomson ("Recent Researches in Electricity and Magnetism," p. 101), air at a pressure of 1-100 mm. of mercury has a conductivity for alternating currents approximately equal to that of a 25 per cent aqueous solution of sulphuric acid. The latter is known to be roughly 1 mho-per-centimeter, so that a centimeter cube would have a resistance of about one ohm. Consequently, air at ordinary temperatures, and at a rarefaction 76,000 times greater than that at sea level, has a conductivity some 20 times greater than that of ocean water, although about 600,000 times less than that of copper.

If we apply the ordinary formula for finding the elevation corresponding to a given air-rarefaction, we find that if the air had a uniform temperature of 0 deg. C., the height of this stratum of air with a rarefaction of 76,000, would be

18.39 log 76,000 kilometers above the sea,
or 89.77 kilometers,
or 55.77 miles.

If the air had a uniform temperature of —50 degs. C. this elevation would be reduced 18.3 per cent, or to 73.3 kilometers (45.5 miles). The temperature of the earth's atmosphere has only been measured within a range of a very few kilometers above the surface of the sea, and consequently the materials are not at hand for any precise calculation of the height of electrically conducting strata. It may be safe to infer, however, that at an elevation of about 80 kilometers, or 50 miles, a rarefaction exists which, at ordinary temperatures, accompanies a conductivity to low-frequency alternating currents about 20 times as great as that of ocean water.

There is well-known evidence that the waves of wireless telegraphy, propagated through the ether and atmosphere over the surface of the ocean, are reflected by that electrically-conducting surface. On waves that are transmitted but a few miles the upper conducting strata of the atmosphere may have but little influence. On waves that are transmitted, however, to distances that are large by comparison with 50 miles, it seems likely that the waves may also find an upper reflecting surface in the conducting rarefied strata of the air. It seems reasonable to infer that electromagnetic disturbances emitted from a wireless sending antennæ spread horizontally outwards, and also upwards, until the conducting strata of the atmosphere are encountered, after which the waves will move horizontally outwards in a 50-mile layer between the electrically-reflecting surface of the ocean beneath, and an electrically-reflecting surface, or successive series of surfaces, in the rarefied air above.

If this reasoning is correct, the curvature of the earth plays no significant part in the phenomena, and beyond a radius of, say, 100 miles from the transmitter, the waves are propagated with uniform attenuation cylindrically, as though in two-dimensional space. The problem of long-distance wireless wave transmission would then be reduced to the relatively simple condition of propagation in a plane, beyond a certain radius from the transmitting station. Outside this radius the voluminal energy of the waves would diminish in simple proportion to the distance, neglecting absorption losses at the upper and lower reflecting surfaces, so that at twice the distance the energy per square meter of wave front would be halved. In the absence of such an upper reflecting surface, the attenuation would be considerably greater. As soon as long-distance wireless waves come under the sway of accurate measurement, we may hope to find, from the observed attenuations, data for computing the electrical conditions of the upper atmosphere. If the attenuation is found to be nearly in simple proportion to the distance, it would seem that the existence of the upper reflecting-surface could be regarded as demonstrated.

Rating of Wattmeters for Three-Phase Systems.

By Charles Brandeis.

THE most common way of measuring the energy in a three-phase circuit is with two wattmeters connected as shown in Fig. 1, in which W_1 and W_2 represent the two wattmeters.

In a perfectly balanced three-phase system at 100 per cent power factor these two wattmeters will read alike, i. e., each will record exactly one-half the total load. As soon, however, as the power factor drops below this value they become divergent in their readings until 50 per cent power factor (or the current lag equals 60 degs.) is reached. At this point W_1 will read the total energy and $W_2 = 0$. Below 50 per cent power factor the wattmeter W_2 will again indicate certain values, but they are negative, i. e., to get the total load the value of W_2 must be deducted from the value of W_1. On the other hand, above 50 per cent power factor the sum of the two readings will give the total load.

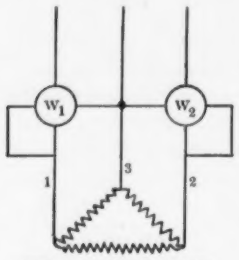


FIG. 1.—DIAGRAM OF CONNECTIONS.

It is, of course, desirable to rate the wattmeters as low as possible, for if they be too large it is not possible to read accurately when the load is small, say, at ¼ full load. Nevertheless, they must be large enough to allow for the inductive loads. To facilitate determining the correct ratings of indicating and recording wattmeters the curves given in Fig. 2 will be found useful.

While the total load curve only shows values up to 100 watts, it is applicable to any other load, the values being in proportion. It will be seen that W_1 reaches its highest reading value at about 85 per cent power factor, and that this value is approximately 58 watts for every 100 watts non-inductive load capacity of the generator or generators. Hence, if the maximum non-inductive load of a generator be multiplied by 0.58, the result gives the highest reading obtainable for W_1 on that circuit. This, however, by no means indicates the rating of the instrument, since wattmeters must be rated as to their non-inductive load capacities. To obtain the *rating* of the instrument we must divide the highest possible reading at the lowest probable power factor by the latter. This may be directly obtained from the W_1 rating curve. Thus if it be assumed in a certain case that the power factor of the generator may drop as low, but will not be lower than 80 per cent, then the rating of the instrument should be $\frac{71.5}{100}$ or .715 times the maximum non-inductive load capacity of the generator.

The wattmeter W_2, on the other hand, as will be seen from the curves, will reach its maximum value at 100 per cent power factor,

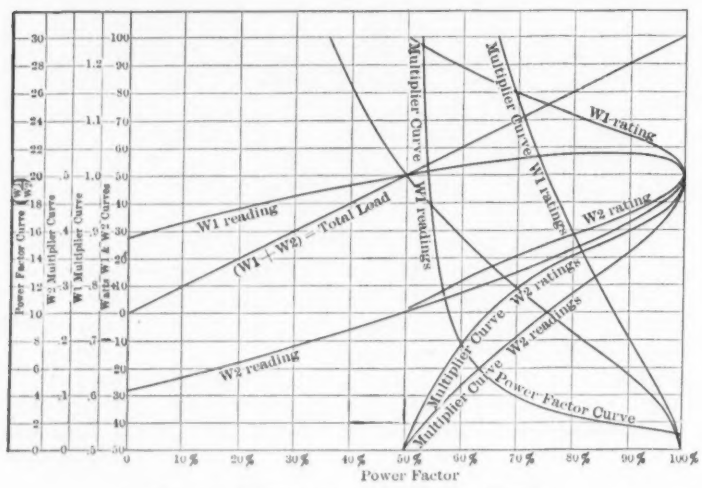


FIG. 2.—CURVES OF WATTMETER RATINGS.

and will, therefore, never record more than 50 per cent of the maximum non-inductive load capacity, and hence the rating may be the latter value.

For determining the correct ratings of wattmeters for motor or other inductive loads we proceed differently. It will be seen that W_1 has always a certain fixed relation to the corresponding total load $(W + W_2)$ for the corresponding power factors. Hence, we have a multiplier curve for W_1 readings, which is obtained by working out $\frac{W_1}{W_1 + W_2}$ for the corresponding power factor values. Similarly, we obtain the multiplier curve for W_1 ratings by dividing the values of the first mentioned multiplier curve by the corresponding power factor value. Similar curves are obtained for W_2. The application of these curves is best illustrated by an example.

Let us assume we have several three-phase induction motors on a circuit which require a maximum of 100 kw, and it is known that at this load the power factor will not be less than 85 per cent and not higher than 90 per cent. We find for 85 per cent power factor the value of the W_1 reading multiplier curve to be .68. Hence the highest reading for W_1 will be 68 kw. The rating of the instrument will be $100 \times .8 = 80$ kw. We find similarly the highest reading for W_2 will be 36 kw at 90 per cent power factor, and its rating 40 kw.

Thus in this case we could take two wattmeters, one of 80 kw, the other of 40 kw capacity. But it must be borne in mind that when the instruments are inserted directly into the circuit, as in Fig. 1, the same current passes through them both, therefore precaution must be taken that W_2 has ample current-carrying capacity. Thus we could take for W_2 a similar instrument as for W_1, but with a different scale. This may involve, however, an instrument of special make. The case is otherwise when the instruments are operated by means of current transformers, and this precaution is not required.

The W_1 and W_2 watts reading curves are obtained from the formula:

$$tan\ \phi = \sqrt{3}\,\frac{(W_1 - W_2)}{(W_1 + W_2)} \text{ where } cos\ \phi = \text{power factor.}$$

While this formula may not generally be known, it is not new, and it is probably well, therefore, to show here how it is deduced:

$$W_1 = C_1 E_{13} cos\ (\phi_1 - 30°)$$
$$W_2 = C_2 E_{23} cos\ (\phi + 30°)$$

Where C_1 and C_2 = the currents,
E_{13} and E_{23} = line pressure,
ϕ_1 and ϕ_2 are the angles of lag of the circuit currents.

In a balanced three-phase system, where

$$C_1 = C_2, E_{13} = E_{23} \text{ and } \phi_1 = \phi_2$$

we obtain

$$\frac{W_1 - W_2}{W_1 + W_2} = \frac{cos\ (\phi - 30°) - cos\ (\phi + 30°)}{cos\ (\phi - 30°) + cos\ (\phi + 30°)}$$
$$= \frac{sin\ \phi}{\sqrt{3}\ cos\ \phi}$$
$$\text{whence } tan\ \phi = \sqrt{3}\,\frac{(W_1 - W_2)}{(W_1 + W_2)}$$

It will be seen that W_1 and W_2 bear a certain definite relation to each other according to the power factor. Hence, we can draw the power factor curve, which will enable one to find the value of the power factor of a system by means of two wattmeters only, without ammeters and voltmeters. Thus, for example, when W_1 reads 60 kw and W_2 reads 30 kw, $\frac{W_1}{W_2} = 2$, which value on the curve gives the power factor 86 per cent.

New Telephone Patents.

The issue of March 4 contains two telephone patents, both relating to switchboard systems and one based on a novel idea, which, however, is unfortunately, of doubtful practical application to actual working conditions on a large scale. This invention aims to supply an automatic signal which shall notify the operator when a line that was busy when called for becomes free, enabling her immediately to connect the subscriber who has made an ineffective call to the line asked for, as soon as it is disconnected from the line it was previously joined to. The idea is excellent, but it is pretty certain that its application would give rise to more troubles than it would cure.

Mr. William S. Paca, of Erie, Pa., patents and assigns one-half to Peter H. Adams, of the same place, a telephone exchange signal system having for its object the provision of supervisory signals in a magneto system which shall show constantly the condition of the two sub-stations connected, much in the same way as the supervisory signals of the common battery system fulfill the same function. Mr. Paca seems bound to make a name for himself as a telephone inventor, but so far it looks as if he would have to be merely content with credit for ingenuity, as in the case of the overflow switchboard

referred to last week. A glance at the diagram (Fig. 1) will show the complicated cord circuit and amount of extra apparatus required to secure on a magneto system a glow-lamp supervisory signal for each sub-station on Mr. Paca's system.

The signals are lamps L and L^1 operated by battery B^2, and controlled by relays H and O. When station No. 1 calls, by throwing drop B in the ordinary way, the operator on inserting plug E in jack C establishes a circuit from ground G at the exchange through battery B, relay H, cord f f^1, line A A^1, to ground G^1 at the sub-station which is thrown on to the central point of the ringer coils by the closing of contact K^1 effected by the release of the switch-hook when the receiver is taken down. Relay H closes contact h^1, and so completes the local circuit l^1 l^2 l^3 containing battery B^2 and lamp L, and L is lighted to full power. When station 2 is connected by means of plug E^1, and the called subscriber has taken down receiver, circuit is established from ground G through battery B and relay O to ground at sub-station 2 in the same manner as described for station 1. This energizes relay O, and the attraction of armature O^1 operates switch O^2, closing contacts R S and h^5, and breaking contact h^2. This brings lamp L^1 into circuit, and the current from the battery divides

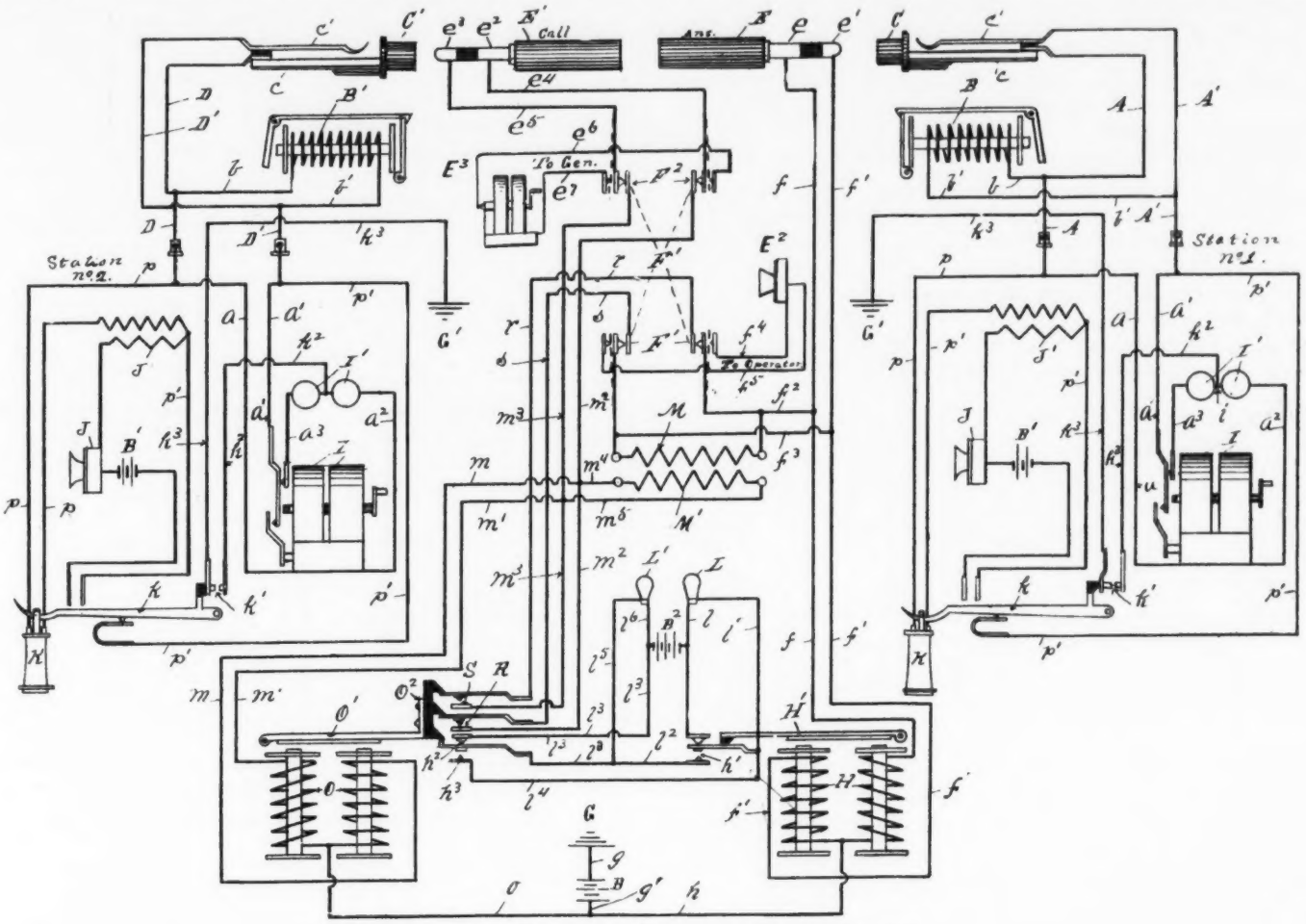


FIG. 1.—PACA'S TELEPHONE EXCHANGE SIGNAL SYSTEM.

and passes through both lamps L and L^1 by wires l l^1 l^4, contact h^3 and wires l^5 l^6 and l^7 lighting and maintaining the lamps at half glow, which indicates to the operator that the lines are connected and in use. The lamps remain at half glow until both subscribers hang up their receivers, when the relays are de-energized and the lamps are extinguished.

Mr. Newman H. Holland, of Brookline, Mass., patents and assigns one-half to Charles W. Holtzer, of the same place, an improvement in telephone exchanges the highly ingenious idea of which is to supply a signal which will indicate when a busy line that has been called for becomes free, indicating also the line which has made the call, so that immediately a disconnection has occurred the waiting connection can be completed. In the words of the inventory the invention is "to provide each operator at the central office with an automatic signal which will indicate when a busy line is clear in case a subscriber has called for connection with said line while it was connected elsewhere, the signal also being provided with means for indicating not only the line called for, but the line which has called for it. Assuming that a certain subscriber wishes to be connected with a certain other subscriber whose line is found to be busy at the time the operator can connect the line called for with a signaling device which will not actually operate until the said line is disengaged, the device being also provided with means for indicating after the signal is displayed the line of the calling subscriber who asked for the connection. The invention is applicable to any existing telephone system, and may be operated through the agency of the ordinary cord connections in conjunction with a suitable switch to connect the signal circuit to the line, or through the agency of a special cord circuit without the intervention of any switch. By utilizing cord circuits in this way the plugs serve as indicators to show the two lines to be connected, and, furthermore, both lines are in this way connected with the signal, so that if the calling line while the subscriber is waiting for the line originally called for has obtained connection elsewhere the signal will not be displayed even when the called line is free. While not essential, this is an important feature of the invention, since the signal will not be displayed until both lines are free, and the operator has nothing to remember, as the plugs indicate which lines they are."

The diagrams show the device applied to a magneto board (Fig. 2) and to a common battery board (Fig. 3), Fig. 4 illustrating a hollow plug for use in connecting the signal circuit to a plug instead of to a jack when that becomes necessary. In Fig. 2, station 241 is connected with station 1409, and station 411 has called for 241, has been told that it is "busy" and has been connected by the signaling device to 241 to await the disconnection of 241 from 1409. The signal consists of a lamp 23 controlled by a relay h, which can be thrown in and out of the cord-circuit by the switch c. The operator, on finding line 241 "busy," when trying to connect 411, connects the two lines by means of the plugs a a^2, depressing the switch c. The jack b^2, in which plug a^2 is inserted, is charged from battery D, by reason of the presence of plug a (connected to D by wire a^{12}, switch member c^3 and wire a^{14}) in one of the jacks of the same line, current, therefore, flows along wire a^{12} of plug a^2, switch-member c^3, which at this point is closed on the lower contacts, wire a^{13}, and through relay h to ground at G. Relay h is, therefore, energized and so remains as long as a plug is in any jack of the line 241.

The relay being energized allows the drop h^3 to fall on one of the contacts of the signal lamp circuit, but this circuit is incomplete until the exterior end of the armature h^3 falls on the other contact, which it cannot do until the relay h is de-energized. This occurs when the original connection of 241 to 1409 is taken down. The removal of

plug *a* cuts off the current, relay *h* becomes inert, and the armature drops and completes the local lamp circuit, thus lighting the signal. By the position of the plugs the operator knows which two lines the signal relates to. As the lines are already connected all that the operator need do is to ring both subscribers and tell them to go ahead.

The application of the device to common battery working requires

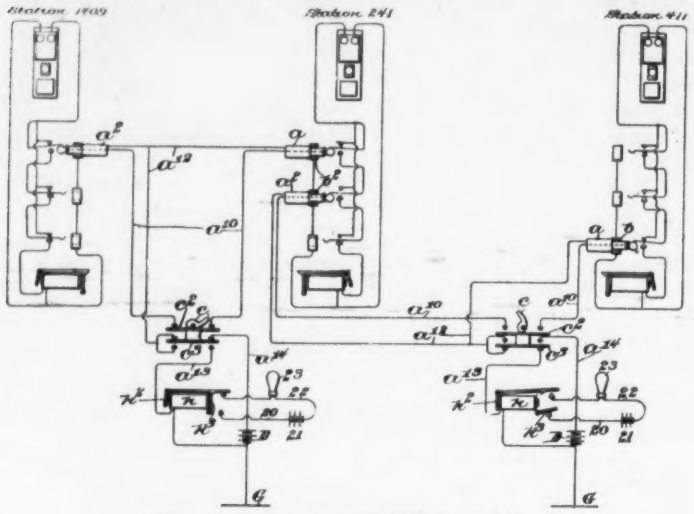


FIG. 2.—HOLLAND TELEPHONE SIGNAL.

a special cord circuit and plugs, as shown in Fig. 3. The signal circuit is practically the same, controlled by the relay *h*, which must be normally energized to keep the circuit of lamp 23 open, closing it only when de-energized. The two special plugs e^2 are shown inserted in jacks of lines 411 and 241, as in the other drawing. The jacks of a connected line being charged from battery *D*, plug e^2 conveys current to relay *h* as long as a connecting plug is in a jack of line 241. When the connection between 241 and 1409 is taken down the current

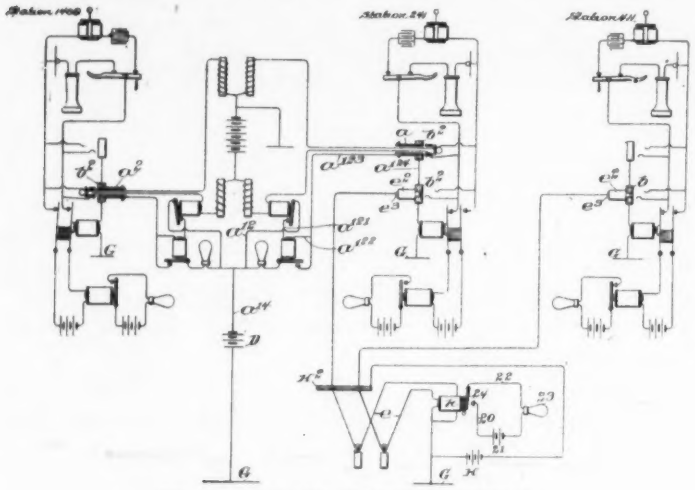


FIG. 3.—HOLLAND TELEPHONE SIGNAL.

is cut off and *h* is de-energized, lighting the signal. The operator then has to withdraw the special plugs and establish the connection between 411 and 241 in the regular way. The special plugs e^2 falling on the plate H^2 close battery *H* on relay *h* by means of the contacts e^3 at the base of the plugs and so maintain *h* energized and the local lamp circuit open.

Fig. 4 illustrates a device for connecting the signal circuit to a

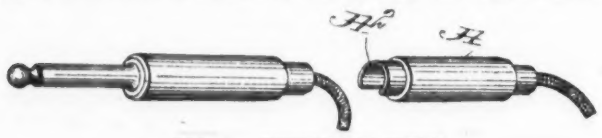


FIG. 4.—CONNECTING DEVICE.

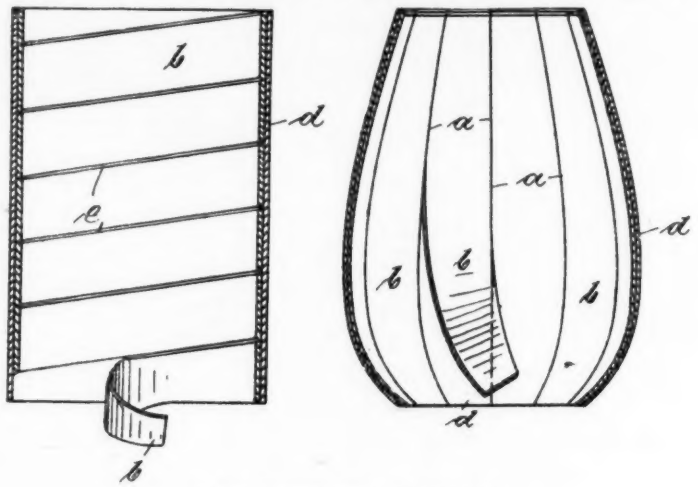
plug instead of to a jack when the jack of the line to be waited for available to the operator is already occupied by a plug which would occur when she herself had put up a connection in the multiple jack of the line in response to a previous call. This is a sort of hollow plug made to fit over the ordinary plug and making contact with it by means of the sleeve A^2.

There are many obvious difficulties in the way of the adoption of this ingenious device in practice in large exchange. To begin with, it is not applicable to trunked connections, which at once bars it out from all large systems, in which trunked calls form the greater proportion of the traffic. This practically limits its field to single exchange system employing multiple boards. In the next place, there is nothing to prevent two or more signal cords being plugged into the same line, and in practice this might be expected to happen often, resulting in a proportionate amount of confusion when several operators simultaneously got the signal to go ahead with a waiting connection—and went ahead. Again, the subscriber whose line was being waited for might often want a connection other than that arbitrarily made for him as soon as his line was free. In fact, so many disadvantages can be foreseen when actual traffic conditions are considered that the outlook for practical use of this invention is very unpromising.

Refining and Electro Deposition of Nickel.

Mr. Titus Ulke, of Sault Ste. Marie, Canada, in a recent patent, proposes a new solution of the old problem of separately recovering copper and nickel from alloys of those metals, and especially from the Bessemerized matter from Sudbury ore, rich in copper and not above 20 per cent in nickel. His method is briefly as follows: The alloy is cast into anodes and as such dissolved in a hot acid solution of the sulphates of its constituent metals, copper cathodes being used and copper precipitated in reguline form. Under these conditions the electrolyte tends to become rich in nickel and poor in copper, and the balance is restored by a double operation consisting in the periodical withdrawance of such proportion of the electrolyte as represents the excess of nickel, and the restoration of a quantity of acid copper solution corresponding to its deficiency in copper. In this manner an invariable constitution of bath is secured, and hence constant electrochemical conditions—a valuable feature, since in refining practice a minute and continuous adjustment of current density is impracticable.

To recover nickel from the withdrawn portions of the electrolyte



ELECTRO-DEPOSITION OF NICKEL.

ammonium sulphate is added, and the acid solution refrigerated, whereby the double nickel-ammonium-sulphate is precipitated, this portion of the process following closely the procedure patented several years ago to Professor Ricketts. Metallic nickel may be obtained by redissolving this precipitate in water, rendering the solution alkaline by ammonia, and electrolyzing hot. In this deposition anodes of lead are preferably used, and are said to remain practically intact. It is to be hoped that this promising method may receive a commercial trial.

The recent work of Foerster and others upon the electro-deposition of nickel has proven the entire feasibility of obtaining thick deposits of the metal, capable of being rolled or hammered, and of the highest technical value for the direct formation of articles by electrodeposit. Such deposits are obtained, however, only from hot solutions, and consequently the usual matrices of wax or fusible compositions are inapplicable. Fusible metal cores are subject to the objection that they alloy with the metal of the deposit to an extent that renders it impossible to obtain clear and brilliant surfaces, and collapsible molds are expensive and difficult of construction. An ingenious matrix, recently patented to Carl Steinweg, of Ludensheid, Westphalia, solves the problem in the manner indicated in the ac-

companying figures. The matrix is formed of a metal or alloy of low tensile strength, of which lead may be taken as an example. The external face of the matrix is smooth and forms the base of the electro-deposit *d*; its inner surface is grooved as indicated at *a* and *e*, along such lines as will permit the sections *b* embraced between the grooves to be torn or stripped from the interior of the finished article. Matrices so formed are free from limitations of form or size.

Statistics of the American Gas Industry.

A report by Mr. Arthur L. Hunt has just been issued by the United States Census Office on the gas industry of the United States during the census year, 1900. They are not only of interest in themselves as showing the condition of a great industry, but are of special value to those engaged in the production of electric current for light, heat and power. According to Mr. Hunt, the indications are that the number of establishments engaged in the industry is not increasing to any considerable extent. This is made clearer when it is stated that while there were 66 new establishments constructed during the past decade, 92 establishments from which reports were received in 1890 failed to make returns in 1900. Of this latter number 47, or over one-half, were not in operation, having been dismantled, closed indefinitely or changed to electric plants. Of the 45 establishments remaining, nearly one-third now distribute natural gas; a few failed to make returns for census purposes; and 18 establishments that were reported separately in 1890 have since lost their identity through consolidation. The number of new establishments seems small when it is considered that of the 1653 cities and towns in the United States having a population of 2500 and over, there were 826 in which no gas was manufactured. Of the 1244 cities and towns with a population of 2500 and over in 1890, there were only 530 not enjoying gas privileges. Of the 877 establishments shown for the twelfth census, 269, or 30.7 per cent, were operated in connection with the generation of electricity, and it was reported in many cases that the production of gas was attended with an actual loss.

In calling attention to the statistics, Mr. S. N. D. North, the chief statistician of the department of manufactures in the United States Census Office, remarks that the modern tendency toward concentration of industrial enterprises is well exemplified in the gas industry, in which there is an increase, as compared with 1890, of but 18.2 per cent in the number of establishments reporting, while the increase in the capital is 119.1 per cent; the average capital per establishment for 1900 is $646,523, as compared with $348,749 for 1890, the average capital in 1900 being nearly double that in 1890. The increase in the number of cubic feet of gas consumed is 83.7 per cent. The average product per establishment has risen from 49,217,670 cu. ft. in 1890 to 76,503,482 cu. ft. in 1900, an average increase of 55.4 per cent per establishment. The reduction in price from $1.42 to $1.035 per 1000 cu, ft., the average price obtained throughout the United States, has caused the value of products to show a lower rate of increase, the $56,987,290 reported in 1890 increasing 32.9 per cent to $75,716,693 produced in 1900.

Mr. Hunt states that in eight States there has been a decrease in the number of establishments. This decrease is caused, as noted above, by the number of establishments reporting in 1890 that in 1900 were either abandoned or had lost their identity through consolidation. The greatest increase in number of establishments reported was in Illinois, which showed an increase of 17, followed by Pennsylvania with 16 additional plants. Of the 66 establishments which commenced operations during the decade, 12 were located in Illinois, 6 in New York, and 5 each in Michigan and Ohio. In Arkansas, California and Illinois new plants were constructed during the census year.

The accompanying table below sums up Mr. Hunt's results:

COMPARATIVE SUMMARY, 1850 TO 1900, WITH PER CENT OF INCREASE FOR EACH DECADE.

	Date of Census.					Per cent of increase.		
	1900.*	1890.†	1870.	1860.	1850.	1890 to 1900.	1860 to 1870.	1850 to 1860.
Number of establishments	877	742	390	221	30	18.2	76.5	636.7
Capital	$567,000,506	$258,771,795	$71,773,694	$28,848,726	$6,674,000	119.1	148.8	332.3
Salaried officials, clerks, etc., number	5,904	‡1,864	§	§	§	216.7	.....	.....
Salaries	$5,273,500	‡$2,143,169	§	§	§	146.1	.....	.....
Wage earners, average number	22,459	12,996	8,723	5,730	952	72.8	52.2	501.9
Total wages	$12,436,296	$8,449,625	$6,546,734	$2,321,536	$390,684	46.3	182.0	494.2
Men, 16 years and over	22,446	12,952	8,705	5,730	950	73.3	51.9	503.2
Wages	$12,431,234	$8,492,797	§	$2,321,536	§	46.4	.....	.....
Women, 16 years and over	10	.....	.....	.....	2	.....	.....	¶100.0
Wages	$4,256	.....	.....	.....	§	.....	.....	.....
Children, under 16 years	3	44	18	.....	.....	¶93.2	.....	.....
Wages	$806	$6,828	§	.....	.....	¶88.2	.....	.....
Miscellaneous expenses	$14,769,022	$7,799,385	†	†	†	89.4	.....	.....
Cost of materials used	$20,605,356	$14,037,087	$10,869,373	$3,667,630	$503,074	46.8	196.4	629.0
Value of products	$75,716,693	$56,987,290	$32,048,851	$12,016,353	$1,921,746	32.9	166.7	525.3

*Includes 15 establishments operated by municipalities. †Year 1880 not reported. ‡Includes proprietors and firm members, with their salaries; number only reported in 1900. §Not reported separately. ¶Decrease.

Electricity in Turkey.

It is well known, writes a correspondent from Turkey, that electricity is under the ban in the Ottoman dominions. Some American electrical appliances—reading lamps, toys with storage batteries attached, etc., were admitted in September, 1900, by the Constantinople authorities after considerable discussion. At Beirut merchants have succeeded in passing through the Custom House dynamos for the operation of Röntgen-ray machines, but generally speaking, the interdiction against electrical goods, and especially against dynamos, telephones and electrical plants, still exists.

In spite of this one hears continually of plans for electric light, electric railways, etc., even in Asiatic Turkey. The late Sir Ashmead Bartlett is said to have secured before his death concessions for electrical plants in Salonica and in Smyrna. Preferential rights for the construction of electric tramways in Beirut and Damascus were granted the Beirut, Damascus & Hauran Railway (French), which subsequently sold the concession to the Societe de Traction in Paris; and the Beirut Gas Company (also French) has preferential rights to introduce electric light in this city.

Lately rumors of still greater undertakings along electric lines have reached us from America. I quote the following press dispatches:

Jan. 8 (Special).—"If the Sultan of Turkey grants to them the concessions that are being sought after, a United States construction company, of Cleveland, O., will construct electric lines from Cairo, Egypt, to Mount Sinai, and along the coast of the Red Sea to Mecca, with a branch from Mount Sinai to Damascus. These lines are already projected, and the company's chief promoter in the Orient says that Palestine, by reason of the Zionistic movement, is full of possibilities for connecting Jerusalem with surrounding towns. The Cleveland company will finance the lines, with the understanding that it shall do the constructing work."

Jan. 9.—"Trolley cars are to displace the patient ass as a means of locomotion in the Orient. Cleveland and Chicago capitalists have been successful in negotiating with J. F. Spanier, of Rome, Italy, for concessions for electrical lines from Cairo, Egypt, to Mount Sinai, and thence along the coast of the Red Sea through Syria and Arabia to Mecca. A branch is to connect Damascus with the system of Mount Sinai. It is figured that business during a single one of

the annual Mahometan pilgrimages to Mecca will pay a handsome profit on the cost of construction. Letters received from Signor Spanier say that the Sultan of Turkey has granted an important part of the concessions for the system. The Cleveland Construction Company is working under an agreement to finance all the undertakings if given the construction contracts."

It is impossible to foretell when electricity will be given a free field in Turkey. But in view of the progress of Western ideas and methods in these regions it cannot be doubted that the day of emancipation is approaching.

Mr. Ibrahim Sabbag, of the powerful firm of H. Sabbag & Fils, in Beirut, is in correspondence with American capitalists with a view to acquire possession of the provisional concessions for electric street railways and electric light plants in Beirut and Damascus, and he is prepared to assist and co-operate with any bona fide American syndicate who may have under consideration electrical undertakings in Turkey in Asia.

Wireless Telegraphy in Paris.

Paris is, it is stated, ambitious to lead the development of wireless telegraphy. A proposal has been submitted to the municipal council to establish wireless telegraph posts on the boulevards and main streets. House owners, shopkeepers, hotels, restaurants and private citizens are invited to subscribe, just as they do at present for telephone service. Each customer is to have a small receiving post in his residence. The proposed wireless system is to be used for business, social and domestic purposes, but the company looks for its main support from the turf fraternity, and intends to install wireless posts on all the racecourses, so that sportsmen sitting at home in their armchairs will be able to follow the races second by second. The novel enterprise has been referred by the City Council to the technical committee. The advices received do not explain how the recipients of the messages are going to translate them.

Annual Banquet of the Automobile Club of America.

The Automobile Club of America gave its third annual banquet at the Waldorf-Astoria on Friday, March 7, when nearly 200 members and their friends sat down to an excellent dinner and heard some admirable speeches. Professor Elihu Thomson talked from the viewpoint of the expert engineer on the influence and mission of the horseless vehicle; Professor F. R. Hutton, of Columbia University, told of the future of the automobile, and Mr. Marconi coupled wireless telegraphy with the evening's topic in a brief speech, which was something of a surprise. For the first time in this country he described experiments successfully conducted by him for the utilization of wireless telegraphy in automobiling as an aid to military operations. He said of this work: "I shall not bother you with a description of the wireless system, because I do not know very much about it myself. I am at home in this company because I am the owner of two automobiles, a steam motor car and a motor cycle. The motor car is of a heavy, powerful type, selected for the purpose of experimenting with the possibilities of its employment with wireless telegraphy in military departments. The car was fitted with my instruments at Thorneycrofts, in England, and I found that I could talk with my base at a distance of 30 miles while touring the country. This was the limit I found possible, and I believe that the auto car equipped with wireless apparatus will be found of practical military service. The system is a handy thing for automobiles in general, especially when you break down and wish to call for help. I had such an experience in England, and was able to send a wireless message to my base, asking that dinner be kept hot. On another trip I thought two English policemen were after me with unpleasant intentions. I sent a message from my automobile and was able to notify friends to be ready to follow after and bail me out if the 'bobbies' should catch up with me."

President Shattuck was heartily applauded when in the course of a careful presentation of the needs of New York State for an improved public highway system he said: "We are ashamed that it has been necessary for the Legislature of this State to pass stringent laws to prevent the abuse of the highways by the owners of automobiles. This club believes that roads belong to all citizens in common, and that the owner of an automobile has no more right upon them than any one else, and, indeed, that the nurse pushing a baby carriage has far more right than he. We do not defend for a moment the driver of an automobile who goes at a furious pace, taking the middle of the road, and blowing his horn as an intimation to the rest of the world that it get into the ditch, or be killed if it stay in the road. There are a few such persons and they should be driven from the highways. We believe that we have persuaded the Legislature at Albany to enact a reasonable law which will prevent excessive speed and the inconsiderate use of the highways."

Borough President Jacob Cantor, of the Borough of Manhattan, promised smooth and unobstructed pavements "inside of two years, and, if we have the luck to stay, two years more."

Grand Rapids, Holland & Lake Michigan Rapid Railway.

At the Chicago Electrical Association meeting, March 7, Messrs. George A. Damon and William D. Ray described the construction and operation of the recently completed Grand Rapids, Holland & Lake Michigan Rapid Railway. Mr. Ray took up that part of the work which came under his supervision as electrical engineer of the Detroit Construction Company, which built the road, and Mr. Damon touched more particularly on the construction of the power house for which the Arnold Electric Power Station Company, of which he is managing engineer, had the contract. This road employs alternating-current distribution with sub-stations and rotary converters. The transmission voltage is 20,000 volts. Both trolley and high-tension feed wires are carried on center-pole construction, between the tracks. Two three-phase high-tension lines are placed on top of the poles on two cross arms and barbed wire is also run at the top of the poles on insulators placed at the apex of each pole for lighting protection. Provo glass insulators were selected. The power house has three-phase Westinghouse generators generating at 390 volts for use at the station direct in operating rotary converters. Step-up transformers raise to 20,000 volts for transmission. Static interrupters have been placed in each high-tension line next to the high-tension transformers. These interrupters are put between the high-tension switches and the transformers, and are for the purpose of avoiding dangerous high-voltage static effects when the circuit is open.

The paper went into the various engineering details connected with the construction of the road to considerable length and contained many features of interest.

Electrical Progress in British Honduras.

Mr. W. L. Avery, the United States Consul at Belize, British Honduras, writes to the State Department as follows: An appropriation of $10,000 has been voted, the consent of the Home Government ganted, the contract signed, and work has begun on the first telegraph line in this colony. This line will extend from Belize to the Rio Hondo, a distance of 100 miles, and offices will be established at Belize, Corozal, Orange Walk, and the Hondo River, and at the last-mentioned place business will be transferred to the overland line through Mexico.

Though Belize is only 850 miles from New Orleans, it has never had the benefit of telegraphic service, and a message from Europe or the United States, if forwarded on a given Thursday, could not be delivered here until 10 days later, and any message would take at least four days, being sent from New Orleans by mail steamer.

It is proposed that a telephone service be established at each of the offices; and in order that one wire may serve both purposes, the circuit will be shut off for two hours each day, giving ample time for local business. As three months are all that are required to build the line, it may be assumed that by May 1, 1902, Belize will be in closer touch with the rest of the world.

A bill is now before the colonial councils extending authority to the district board of Belize to contract for the establishment of an electric light plant in this town, and granting the contractor the privilege of lighting public and private houses. The bill will undoubtedly become a law, and the oil lamps of this town will soon be a thing of the past. The equipment for the telegraph line has been ordered principally from New York, and the material for the lighting plant will also be ordered from the United States.

CURRENT NEWS AND NOTES.

CORNWALL CANAL PLANT.—In the article in our issue of March 1 it should have been added that the plant was constructed by T. Pringle & Son, under the direction of their engineer, Mr. F. H. Leonard, Jr.

MOVING SIDEWALKS.—Commissioner Lindenthal, of the Brooklyn Bridge, has proposed the adoption of the moving sidewalk plan, to relieve the congestion of travel there, and would run the "sidewalks" across the Bridge and back in a circle, as at Paris in 1900. He would use three tracks, with speeds of 2½, 5 and 7 miles an hour.

NEW YORK ELECTRICAL SOCIETY.—The 222d meeting of the New York Electrical Society will be held at the College of the City of New York, corner Lexington Avenue and Twenty-third Street, at 8 o'clock, Friday evening, March 14. Professor Joseph W. Richards, of Lehigh University, will lecture on "The Electro-Chemical Industries at Niagara Falls."

"TELAUTOGRAPH" EXPERIMENTS.—The following dispatch, which may possibly refer to the "telegraphone," was sent from Paris on March 8: "The telautograph, an instrument which transmits handwriting by telephone, has just been tried in the central telephone office of Paris. Experiments were conducted over the Paris-Lyons wire, and, except for a slight tremor due to induction, were perfectly successful."

WIRELESS TELEGRAPHY FOR U. S. NAVY.—A special telegram from Washington of March 3 says: "On the recommendation of Rear Admiral Bradford, chief of the Equipment Bureau, the Navy Department has arranged for a test of the comparative merits of the wireless telegraphy systems of Marconi and Slaby and Arco, the German inventors. Sets of instruments have been ordered and the test will be made between the Washington Navy Yard and the Naval Academy at Annapolis. Stations are being erected at the Navy Yard and the Academy."

EXPOSITION DEBRIS.—The following from the *Pall Mall Gazette* is interesting, but we do not vouch for it: There are still vestiges of the Great Exhibition encumbering the Champ de Mars. Some one has wondered what has become of the Trottoir Roulant, which carried its passengers, leaning in a melancholy attitude upon its brass-knobbed sticks, round the Exhibition, and incidentally round a great deal of Paris. It was carried away to Australia, there to pursue its snake-like course for the pleasure of the Colonials, but its last end appears to have been the scrap heap. As to the electric railway, that is doing duty as a common train in Brittany. But at least it has its use in the world.

IOWA TELEPHONE ASSOCIATION.—A meeting of the Iowa Telephone Association, in Des Moines, Iowa, is scheduled for March 11 and 12. Following is the programme: "A Clearing House System for Settling Interline Toll Accounts," by Dr. Herr, of Ottumwa; "An Iowa Tariff Book," by E. H. Martin, Webster City; "Toll Line Traffic," by George N. Bandy, of Perry; "One Year's Experience with Checking Bureau," by Dr. Bennett, Waterloo; "Our Duty to Each Other," by P. C. Holdoegel, of Rockwell City; "What I Know About the Farm Line Movement," by F. C. Musson, of Atlantic. Papers will also be read on "Cable Work for Small Exchanges," and "Shall We Establish a Central Purchasing Bureau?" Mr. H. C. Raney, of Fairfield, is president of the Association, and Mr. Charles C. Deering secretary.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—The applicants for membership in this society now number more than 300. The inaugural meeting will be held in Philadelphia Thursday evening, April 3, and is to be followed on Friday and Saturday by sessions to be held at the electro-chemical lecture room of the University of Pennsylvania at Philadelphia, for the reading of and discussion of papers. Twenty papers have been promised, and a large proportion of prospective members from the Eastern and Western States will attend. Friday evening will probably be devoted to social intercourse, and Saturday afternoon to visits to places of interest to electro-chemists. The detailed programme of the meeting will be duly issued. Mr. Carl Hering, 929 Chestnut Street, Philadelphia, is temporary secretary.

OMAHA UNDERGROUND WIRES.—The Omaha City Council has passed an ordinance requiring all electric wires used for light, heat, power and other commercial purposes, excepting telephone, telegraph and street car service, to be placed underground, in the business district of the city, before May 1, 1903. The conduits are to be constructed under the supervision of the city electrician, and work will begin immediately. The Nebraska Telephone Company have had a system of conduits in use for several years, but claim they have none to rent. The New Omaha Thomson-Houston Electric Light Company has had a plan under consideration for some time, but wished to be assured that any other lighting company attempting to install a plant in Omaha would not be permitted to string overhead wires when they had been themselves at a heavy expense to put wires underground.

TELEPHONING OVER TELEGRAPH CIRCUITS.—A telegram of March 3 from Chicago says: A train crew 400 miles from Chicago talked over the telegraph wires yesterday with Chief Operator Parsons, of the Illinois Central Railroad, at the Twelfth Street depot. As a result the railroad telephone invented by R. J. Tillman was declared to be a success. The train was stopped near Fulton, Ky., and theTillman telephone was connected with the regular telegraph wire running to Chicago. In spite of the fact that the message had to travel over iron wire, which ran parallel to more than a score of other wires, every word was distinctly heard by Mr. Parsons. The inventor asserts that it makes no difference whether or not telegraphic messages are being flashed over the wires simultaneously with the telephone message. This was tested by the successful transmission of a telegraphic communication from Fulton at the same time Parsons was conversing with the crew.

TELEPHONY IN CANADA.—The Dominion Government bill recently brought forward regulating telephones and telegraphs provides that the lines shall be so constructed as not to interfere with the public use of roads and highways or impede free access to any building. Tolls may be fixed for either the whole or any particular part of the company's line, but such tolls are to be uniform to all persons, and are to be approved by the Governor in Council. No company is to make any secret rebate to any customer. After two months' notice, the Government may assume possession of the property of any company, and, in the event of a difference as to compensation, reference is to be made to three arbitrators. A clause makes it compulsory upon a telephone company to supply telephone connection to any applicant upon the payment of lawful tolls. Power is vested in the Railway Committee of the Privy Council to determine any complaint respecting tolls charged by telephone or telegraph companies, unjust preferences by any company, and anything which the act requires or prohibits.

TREATMENT OF REFRACTORY GOLD ORES.—A patent issued March 4 to Henry Renner Cassel, of New York, proposes to treat such refractory gold ores as the sulphides and tellurides by electrolytic oxidation, thereby avoiding the preliminary roasting and its attendant losses. The ores are converted into a pulp with dilute sodium chloride solution, and agitated between carbon electrodes, the polarity of which may be reversed at will. Tellurium and sulphur are oxidized and the precious metal dissolved, the latter being at once reprecipitated in the form of a black non-adherent powder, which is scoured from the cathode by the abrasion of the core, and remains in the pulp, to be afterward recovered by the addition of cyanide or other suitable solvent. The apparatus, which forms the subject of a separate patent of the same date, consists of a carbon-lined vat with a carbon agitator, the lining and stirrer constituting respective electrodes. The novel feature of the process lies, not in the oxidation of refractory ores through the intermediary of the oxychlorides of sodium, but in the maintenance of current conditions to precipitate the gold in the particular readily soluble form above referred to.

UNDERGROUND WIRES.—Because of its experience in the recent storm the Pennsylvania Railroad Company has decided to lay all its wires between New York and Philadelphia underground, and will start the work at once.

PENSIONS TO EMPLOYES.—The New York Metropolitan Street Railway announces a plan for the establishment of a pension system for superannuated employes. The maximum age is 70 years, but those whose ages range from 65 to 69 may be retired under pension if found incapable.

INFORMATION WANTED.—We have received the following communication: "Gentlemen: I'm making parts of some new motive power machines and cannot put them together. Some one in the tenement over the shop wants to steal the idea with an X-ray machine. *How can I successfully prevent its action?*" We might suggest moving out.

"AT THE TELEPHONE."—A few months ago a gruesome play of the above title was produced in Paris. It has now been done into English, and a cable dispatch of March 1 says: "Charles Warner created a veritable sensation by his terribly realistic presentation of 'Heard at the Telephone.' This is one of the most blood-curdling of even the French plays, and Mr. Warner's portrayal of the husband who listens at the telephone miles away while his family are being murdered by burglars won for him an ovation such as London first-nighters rarely give."

LIGHTING ST. PAUL'S CATHEDRAL.—A cable dispatch from London, of March 8, says: The long-talked-of installation of electric light in St. Paul's Cathedral is nearly completed. Worshippers on Easter eve will see the new light there for the first time, though not in entirety, perhaps. All the wires are now ready, but for some reason there has been delay in getting the standards fixed. Not quite all of these will be fixed by Easter, but the choir will be seen in a blaze of light. It is estimated that the change from gas to electricity, the gift of Mr. J. Pierpont Morgan, will cost $50,000.

SHAWINIGAN FALLS TRANSMISSION.—The Shawinigan Water & Power Company has about completed its arrangements for the transmission of power from Shawinigan Falls, Que., to Montreal, a distance of about 80 miles. The Shawinigan Company has decided to use aluminum wires, in place of copper, for transmitting energy to Montreal. The Pittsburg Reduction Company is already manufacturing aluminum, on a large scale, at Shawinigan, and the company intends to at once install a plant for the working of aluminum into wire of various forms, including cables for the transmission of electric power.

AUTOMOBILE ENDURANCE RUN.—The Automobile Club of America will hold a 100-mile non-stop endurance contest on Decoration Day, Friday, May 30, 1902, starting from the clubhouse at Fifth Avenue and Fifty-eighth Street, and running 50 miles to a point near Bridgeport, Conn. (Southport), turning there and running back over the same road to the clubhouse without stopping. The road will be marked by yellow arrows. Reliability and endurance (not speed) are the underlying principles of the contest. The officials are: Winthrop E. Scarritt, chairman; George F. Chamberlin, John A. Hill, contest committee.

FIFTY-THOUSAND-VOLT TRANSMISSION TO B JTTE.—Word has just been received from M. H. Gerry, Jr., manager of the Missouri River Power Company, of Helena, Mont., that the 50,000-volt transmission line which this company recently built from its power house at Cañon Ferry on the Missouri River to Butte, Mont., has been successfully started, that the load is being taken on slowly and that all is working smoothly and no trouble is being experienced. Particulars of this 70-mile transmission can be found in ELECTRICAL WORLD AND ENGINEER of July 13. The transmission line of the Bay Counties Power Company, of San Francisco, has been designed to operate ultimately at 60,000 volts, but at latest reports had not been raised above the 40,000 volts at which it was recently started. If this is true, the Cañon Ferry Butte line is operating at the highest voltage yet put in every-day commercial use. The Bay Counties line has been run at 80,000 volts for short periods.

PROPOSED ELECTRIC RAILROAD IN SWEDEN.—Mr. Robert S. S. Bergh, United States Consul at Gothenburg, Sweden, writes the State Department as follows: The problem of employing electric power instead of steam for railroads receives more and more attention in Sweden. It is stated that the managers of the State railroads are making investigations in this direction, and a recent newspaper article announces that private concerns are also interested in the matter. A Gothenburg newspaper reports that the board of managers for the Falun-Vesterdalarnes Railroad Company has sent to the government a petition for the gradual adoption of electric locomotives, instead of steam engines, throughout the whole country, and the utilization of water power. The petition mentions that a machine firm in Switzerland has made a proposition to use the Huber system, by which an electric current can be generated when a train passes down inclines, which current can be utilized by other trains on the same road. The Swiss firm proposes to furnish the necessary rolling stock, a Swedish company will suply the electric power, and the railroad company is to furnish railroad lines for the experiment. But cash is still needed for the building of transformers, for raising the current to 16,000 volts and changing the same from three-phase curent to two-phase, for electric connection of the rails, etc., all of which it is estimated will cost 100,000 kronor ($26,800). The petitioners ask the government to furnish the money needed.

ELECTRO-PLATING BATHS.—M. Jules Meurant, of Liege, Belgium, in a recent patent describes a series of baths for the electrodeposition of zinc, tin, nickel, copper and silver, the characteristic feature in all cases being the addition to a neutral or alkaline solution of the metal, of an organic non-electrolyte, generally a carbohydrate, and in the majority of cases a polyatomic alcohol or derivative. The chief interest of the patent is in the bath described for the deposition of adherent coatings of zinc upon steel. This solution is formed by precipitating zinc from its chloride solution as carbonate, redissolving in ammonium chloride, and adding for each kilogram of zinc chloride taken, 300 grams of gum arabic or equivalent amounts of sugar or glucose. The patentee states that steel tubes coated with zinc from this bath were successfully submitted to the following tests preparatory to their acceptance by the Dutch Navy: (1) Crushing to completely flatten the tube; (2) folding the flattened tube upon itself; (3) crushing a ferrule cut from the tube in the direction of the axis of the cylinder; (4) elongation test of 27 per cent; and that the protecting layer of zinc showed no alteration either by scaling or breaking. Zinc baths containing carbohydrates are well known in the art, having been patented in France by Blas and Miest, in Germany by Kaselowsky and Basse, and in this country by Frauenfelder and Meyer; the claims of the present patent are limited, therefore, to the specific procedure in preparing the electrolyte.

ELECTRO-CHEMISTRY IN SPAIN.—Mr. Julius G. Lay, U. S. Consul General at Barcelona, Spain, writes in a report to the U. S. State Department: The important trade in "rough" chemicals for industrial purposes, for her supply of which Spain was entirely dependent upon foreign countries, induced some resident German engineers to plan the construction of works for the manufacture of two of the chief articles, i. e., chloride of lime and caustic soda. The electrolytic system of production was selected, and the company, under the name of Sociedad Electro-Quimica de Flix, commenced building operations in 1896 at the town of Flix, about 100 miles from Barcelona, on the railroad to Madrid, securing easy facilities of transport, cheap labor, a sufficient water supply, and access to plentiful limestone and salt deposits. The company started with a capital of 4,000,000 pesetas (about $600,000), and the estimated output of the works was 5000 tons of chloride of lime and 2000 to 2500 tons of caustic soda. At the end of 1899, the company began to place its manufactures on the market, causing some uneasiness to the foreign makers of these articles, as prices at that time had a decided upward tendency, and it was feared that considerable sacrifices would be necessary to meet the new competition. So far as can be ascertained, however, the Flix works have not fulfilled expectations. Foreign manufacturers have not suffered to any appreciable extent, and the imports of bleaching powder and caustic soda during the last two years show little, if any, falling off.

LORD KELVIN, accompanied by Lady Kelvin, has arranged to sail for this country April 12, arriving April 19. The American Institute of Electrical Engineers is consulting his wishes by arranging to hold the proposed reception in his honor on Monday, April 21. Columbia University seems likely to be the place. Lord Kelvin will be here only two or three weeks.

A BOOK BY MR. MARCONI.—"Wireless Telegraphy" is the title of the volume just completed after two years' work by Marconi. It will be published this spring by McClure, Phillips & Co. It recounts the experiments from the beginning to the final success, when the three dots received on the Newfoundland coast told the young inventor that he was in communication with Europe. The book is not technical, but it explains the new science of telegraphy so as to make it interesting and comprehensible to the general reader. It also is said to give an insight into the personality of this "twenty-seven-year-old wonder-worker." Mr. Marconi will, it is stated, personally supervise the making of the book, which includes many diagrams of scientific importance.

WIRELESS TELEGRAPHY IN MEXICO.—For some time a number of employes of the Mexican Federal telegraph lines have been busily engaged with a series of wireless telegraph experiments in the vicinity of Vera Cruz. This work is being done on the flat country adjacent to the coast, and proved so successful that the Government will prosecute it on a much more extensive scale. The present apparatus is placed on elevated platforms 14 meters above the ground. The employes will leave for Yucatan on the receipt of the necessary equipment that will permit them to continue their operations on a larger scale. The distances between the sending and receiving instruments will be gradually increased, and the effect of extending the distance will be carefully studied. It is possible that before the close of the present year the work will have so far advanced that the various ports along the coast will be equipped in such a manner as to allow of their uninterrupted intercourse with each other, as well as with the various lines of vessels that ply between Mexican ports.

NEW MEMBERS OF THE INSTITUTE.—At the meeting of the board of directors of the American Institute of Electrical Engineers on the afternoon of February 28, the following associate members were elected: Ayres, Albert Doane, salesman Westinghouse Electric & Manufacturing Company, 3803 Grand Boulevard, Chicago, Ill.; Burton, Charles Gillette, salesman Westinghouse Electric & Manufacturing Company, 6328 Greenwood Avenue, Chicago, Ill.; Chester, M. E., telephone engineer Western Electric Company, 463 West Street, New York; Chubbuck, Leonard Burrows, checker in draughting room, Westinghouse Electric & Manufacturing Company, Pittsburg, Pa.; Cooper, William, general superintendent, Bullock Electric Manufacturing Company, Cincinnati, Ohio; Cowen, Julian Betty, manager of export department, General Incandescent Arc Light Company, 572 First Avenue; Dryer, Erwin, salesman and engineer, Westinghouse Electric & Manufacturing Company, Chicago, Ill.; Eley, Josiah Norfleet, electrician and operating engineer, Georgia Electric Light Company, Atlanta, Ga.; Ferris Robert Murray, Jr., engineering department, the N. Y. & N. J. Telephone Company, 81 Willoughby Street, Brooklyn, N. Y.; Fuller, Edwin Ernest, representative engineer for Scotland for the British Thomson-Houston Company, Abbottsford, St. Andrews St. Ayr, Scotland; Lloyd, Edward William, assistant superintendent of construction, Chicago Edison Company, 139 Adams Street, Chicago; Miller, Geo. E., assistant to fourth vice-president E. & M. Company, 4911 Center Avenue, Pittsburg, Pa.; Morrill, Edward Francis, engineering department, the New York & New Jersey Telephone Company, 81 Willoughby Street, Brooklyn; Mulligan, Walter Lyon, assistant manager United Electric Light Company, Box 812 Springfield, Mass; Lowson, David, electrical inspector, Department of Electricity, 1721 Park Row Building, New York; Marbury, L. C., electrical engineer, General Electric Company, Schenectady, N. Y.; Ter Meer, Henry C., tester in meter department, Brooklyn Edison Company; Nichols, Louis Charles, electrical engineer, the Converse Transformer Company, Pittsburg, Pa.; Price, Norman I., Sibley College, Cornell University, Ithaca, N. Y.; Gaylord, Truman Penfield, engineer, Westinghouse Manufacturing Company, 610 Dearborn Avenue, Chicago, Ill.; Gibson, John Jameson, salesman, Westinghouse Electric & Manufacturing Company, 171 La Salle Street, Chicago, Ill.; Green, Chas. Maxwell, engineer on Brush arc dynamos, General Electric Company, Lynn, Mass.; Kintner, Charles Jacob, solicitor of patents and expert, 45 Broadway; Kintner, Samuel Montgomery, professor of Electrical Engineering Western University of Pennsylvania, Allegheny, Pa.; Remschel, Cesar Wilhelm August, G. P. O., San Francisco, Calif.; Ruffer, Chas. Shumway, electrician, the Telluride Power Co., Telluride, Col.; Sawyer, Willits Herbert, engineer railway engineering department General Electric Company, Schenectady, N. Y.; Sharp, Clayton Halsey, test officer lamp testing bureau, 14 Jay Street, New York City; Sloan, James Richard, electrical engineer, the Pullman Company, P. R. R. Depot, Jersey City, N. J.; Thomas, Alfred Clarence, engineer, the New York & New Jersey Telephone Company, 81 Willoughby Street, Brooklyn, N. Y.; Wagoner, Philip Dakin, commercial department, General Electric Company, Schenectady, N. Y.; Wilkinson, James, chief engineer Birmingham Railway, Light & Power Company, Birmingham, Ala.; Woodfield, Sydney, assistant engineer Electrical Power Distribution Company, York House, Norfolk Street, London, England. The following associates were transferred to full membership: H. S. Wilson, superintendent Puebla Electric Light Company, Puebla, Mex.; Christopher M. Goddard, secretary, National Underwriters' Association, Boston, Mass.; Byron T. Burt, superintendent, Chattanooga Electric Light & Power Company, Chattanooga, Tenn.; Lewis A. Howland, engineering department, Canadian General Electric Company, Montreal, P. Q.

LETTERS TO THE EDITORS.

Indicator for Measuring Angular Variation.

To the Editors of Electrical World and Engineer:

Sirs.—Having worked along a similar line, I read with much interest the account of the very ingenious arrangement for measuring the angular variation in the speed of flywheels, described by Mr. Mix in your issue of Feb. 8, 1902.

My experience with such devices indicates that possible sources of inaccuracy in the combination described are unevenness in the transmission of motion from the flywheel to the pintle of the friction wheel, and variations in the speed of the inertia wheel, the angular motion of which would possibly have different values, depending on whether the variation in the angular motion of the flywheel had a high or low rate of change. The air friction on the inertia disk would not be inconsiderable.

If the aluminum disk and the inertia wheel run 40 times as fast as the flywheel, there will be indications of the angular variation of speed of the flywheel at points in its motion of revolution 9 degs. apart, plus or minus a small amount depending on the angular speed variation. Hence, as the spots of light must follow each other rapidly, I believe to be correct the opinion expressed in the editorial note on the subject as to the difficulty of measuring the amplitude of vibration of the spot of light, for the spot would be of a very evanescent and elusive character.

I say this advisedly after many experiments with a device now nearing completion, the details of which will shortly be made public. This is intended to give the value of the speed of a flywheel in feet per second at any point in its motion of revolution. I have had great difficulty, just on acount of the elusive character of the value to be measured, in determining whether the readings obtained were accurate or not. Numerous experiments under varying conditions had to be made to locate the different causes of error, and one by one they were discovered and either removed or compensated for, until at this time the device is, I believe, an instrument of precision.

The device has a positive connection with the flywheel in contradistinction to a friction drive, and the scale is so arranged that the value of the speed can be as easily read, as atmospheric pressure is on an aneroid barometer. With this instrument the value of the speed at positions a small angular distance apart can be measured accurately in feet per second, and curves of angular speed variation can then be plotted, using either the rectilinear or polar system of co-ordinates.

The distinction between Mr. Mix's device and the one above referred to is that his will indicate the maximum angular variation of the speed, while the other will give the absolute value of the speed of the flywheel at any point of its motion. The device is also capable of gen-

eral application as a speed indicator, and the body whose motion is to be measured may move in either a rectilinear or curvilinear path.

BALTIMORE, MD. J. W. DARLEY, JR.

Measuring Three-Phase Circuits.

To the Editors of Electrical World and Engineer:

Sirs.—Your issue of Feb. 22 contains a letter giving what appears to the writer, Mr. M. G. Stratton, to be a peculiar state of affairs in metering the input in watts to a three-phase induction motor. Mr. Stratton has overlooked the fact that with a balanced three-phase load there is normally a phase displacement of 30 degs. between the current in one of the conductors (*A*) and the e. m. f. between this conductor and either of the other two (*A* to *B*, or *A* to *C*), even when the load is quite non-inductive.

Under these conditions (i. e., balanced non-inductive load) the two single-phase wattmeters connected as shown will read the same, and if compared with volt and ammeter readings will point to a power factor of 86.6 per cent, in spite of the fact that load is non-inductive, and hence power factor actually 100 per cent. Now, if the load is kept balanced, but made sufficiently inductive to cause a lag of 30 degs., the current and e. m. f. in one wattmeter will be in phase (30 degs. — 30 degs. = 0 deg. displacement), and for the other wattmeter will have an angular displacement of 60 degs. (30 degs. + 30 degs.).

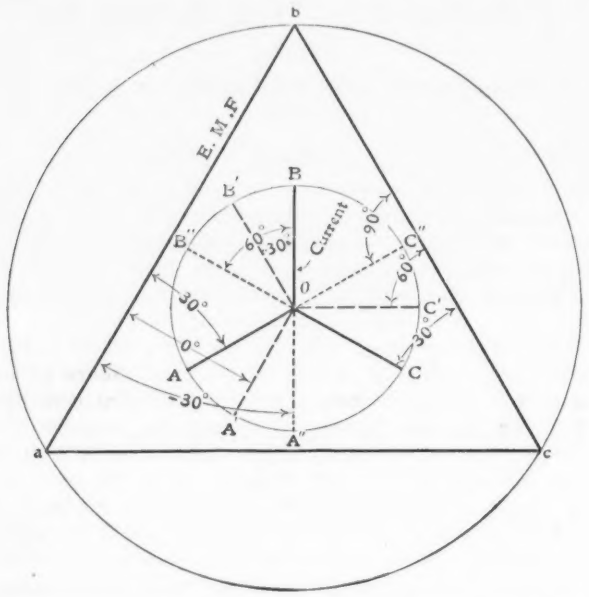


DIAGRAM SHOWING ANGULAR RELATIONS BETWEEN CURRENT AND E. M. F.

Again, comparing with voltmeter and ammeter, the first wattmeter will figure out 100 per cent as power factor, and the second wattmeter 50 per cent. Under this condition the power factor of the three-phase load is actually 86.6 per cent. If now the inductance is increased sufficiently to cause a lag of 60 degs., the power factor of the system will be actually 50 per cent, the current and e. m. f. in first wattmeter will be 30 degs. apart (30 degs. — 60 degs. = — 30 degs.), and for the second wattmeter 90 degs. apart (30 degs. + 60 degs. = 90 degs.). The second wattmeter will not run or indicate, and any further lag of current, i. e., power factor below 50 per cent, will cause this meter to run backwards if a recording instrument, or if an indicating instrument the needle will swing the other side from the zero.

The accompanying diagram shows the angular relations between current and e. m. f. The current coil of first wattmeter is in series with lead *A*, and its pressure coil between *a* and *b*. The second wattmeter has current coil in lead *C* and pressure coil connected *c* — *b*.

Referring to the diagram, *a b c* is the triangle of e. m. f. *OA, OB* and *OC* show phase relation of current for a non-inductive load, or 100 per cent power factor. *OA'*, *OB'* and *OC'* for a load with 30 degs. lag, 86.6 per cent power factor; *OA''*, *OB''* and *OC''* for a load with 60 degs. lag, 50 per cent power factor.

For the test quoted by Mr. Stratton the power factor should be determined in this manner:

True watts delivered to motor from sum of wattmeter readings,

8,000
3,600

11,600 watts

Apparent watts delivered to motor from ammeter and voltmeter readings:

600 volts × 15 amperes (per phase) × $\sqrt{3}$ = 15,570 watts (apparent)

$$\text{Power factor} = \frac{\text{True watts}}{\text{Apparent watts}} = \frac{11,600}{15,570} = 74.5 \text{ per cent.}$$

The figures appear to indicate that the motor, if a modern type, is about two-thirds loaded, and the power factor for a machine of this size should be somewhat better than the 75 per cent indicated.

BROOKLINE, MASS. JOHN TAYLOR.

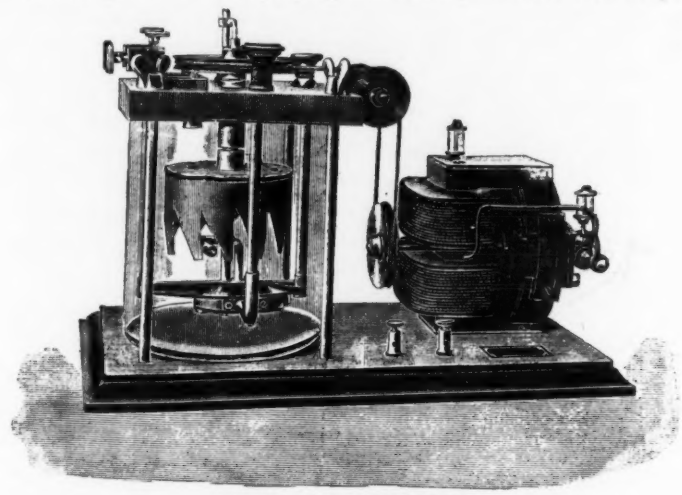
Mercury Jet Interrupter.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of Oct. 12, 1901, I read with much interest an article by Dr. Cunningham describing a mercury jet interrupter. He mentions besides other advantages of this apparatus the possibility of varying the duration of the closing of the current from the exterior by employing V-shaped steel leaves and a means of adjusting the same.

I take the liberty of referring to the fact that my jet interrupter, described in No. 41, 1899, of the *Elektrotechnische Zeitschrift*, and in No. 19, Vol. XXXIV., 1899, page 713, of ELECTRICAL WORLD AND ENGINEER, possesses this same means of adjustment, but is much simpler in form.

Referring to the accompanying illustration, an ebonite screw permits the mercury jet to be elevated or lowered while the V-shaped steel leaves are rotating. Moreover, the variation of the number of contacts is accomplished in the same manner as in the construction of Dr. Cunningham, namely, by means of screws attaching the leaves to the disk.



MERCURY JET INTERRUPTER.

It is a matter of opinion whether the non-employment of a fluid non-conductor is an advantage. At present much favor, it may be remarked, is shown toward breaking circuits under oil. I do not consider that alcohol is appropriate, and in my interrupter I use petroleum. This fluid evaporates but little, it has a very high point of ignition and up to date has not given rise to any dangerous explosions in my interrupter. Several hundred of my mercury jet interrupters are in use in Europe for Röntgen ray purposes, and with Tesla and wireless telegraph apparatus. Some of the interrupters are also in use in your country.

In conclusion, I may refer to a remark of Dr. Cunningham, that he proposes to apply "properly adjusted air-gaps in series with the tube." Such sparking gaps make, however, a disagreeable noise and weaken also the useful spark at breaking contact. I, therefore, have used for some time choking tubes or "valve tubes" (Drosselrohren), which weaken the spark only at making contact, but let it pass almost without obstacle at breaking contact. These tubes are simply attached to the Röntgen ray tube, and their use is very advantageous, especially in the operation of "soft" Röntgen ray tubes.

BERLIN, GERMANY. MAX LEVY.

A 19,000-Volt Shock.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of Jan. 11, 1902, I notice a communication from Mr. J. R. Cravath relating to an accident to an employe at the Santa Ana Cañon power transmission plant, California. The accident occurred about as related, but the statement that the man received no very large volume of current is in error. In point of fact, the man received a shock of sufficient volume of current at 19,500 volts to blow the fuses on the 750-kw, three-phase, 50-cycle alternator, which was fused to double its normal running capacity.

It is my opinion, formed from noticing short circuits of various resistances which have come in on that line at various times, that this man received at least 50 amperes through his body. The flesh was charred on his heel to the bone, and the flesh on his scalp for a space of 3 inches in diameter was burned to a crisp. The bone was also burned to a crisp, a piece of the bone 3 inches in diameter coming out of the skull of its own accord, leaving the brain bare.

The man sustaining this accident did not remain in this locality until cured, but, I believe, the wound healed without any grafting of skin. I saw the man a few weeks ago, and he is as well and in full possession of his faculties as any man could be. He is now superintendent of the San Joaquin Electric Company's plant at Fresno.

The writer believes that no shock of any potential whatsoever is necessarily fatal, unless the victim has some organic heart trouble, provided the contact endures for but a few seconds and resuscitation is begun within 15 minutes; but no one should become discouraged and cease to endeavor to revive the victim of such an accident for at least two hours. This man came to after an hour and fifteen minutes of patient, deliberate application of the methods of resuscitation as published some years ago by the *Electrical World*.

LOS ANGELES, CALIF. O. H. ENSIGN.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Iron Alloys; A New Transformer Iron.—BARRETT and BROWN.—A long abstract of a very long (Brit.) Inst. Elec. Eng. paper on "Researches on the electric conductivity and magnetic properties of upwards of 100 different alloys of iron." The adjoining Fig. 1 gives

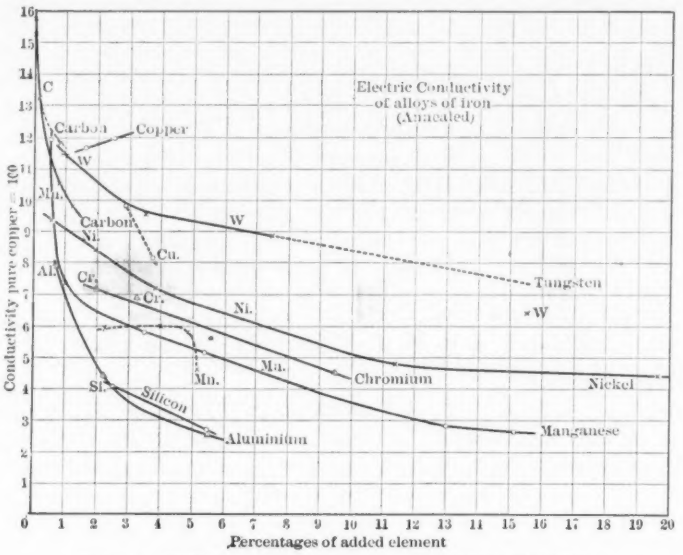


FIG. 1.—ELECTRIC CONDUCTIVITY OF ALLOYS OF IRON.

the change of electrical conductivity for the admixture of one element in increasing percentages to iron. Copper being taken as 100 conductivity, the curves must all begin at about 16, which is the conductivity of pure iron. It will be seen that the greatest reduction of conductivity is always produced by the first increments of the element added. As the percentage increases, the effect produced becomes less, and in the case of the more highly resisting alloys such as nickel and manganese, the difference between the conductivity of a 13 and 18 per cent alloy is hardly perceptible. The effect of carbon is so great that the conductivity of a specimen affords a rapid method of estimating the amount of carbon present. The specific resistance of the added metal affords no clue to that of the alloy. Electric and thermo-conductivity go together in all cases, and the increase of specific resistance of the alloy follows the same order as the increase of the specific heat of the added element, i. e., as the atomic weight decreases. The highest electrical resistance of any known metallic wire, commercially useful, has been found in some of the composite iron alloys. Thus an iron alloy containing 25 per cent of nickel and 5 per cent of manganese has a specific resistance of 97.5 microhms, and a comparatively low temperature coefficient. This alloy is easily drawn into wire, appears to undergo but little change in heating, and is not an expensive product. They then give the results of their tests of the magnetic properties. In general, the addition of anything to pure iron is likely to spoil its softness and permeability, but this is not universal. Silicon, and especially aluminum, improve it when not present in too great quantity. On the other hand, nickel first almost destroys it, so that the specimen becomes almost non-magnetic, but more than 25 per cent makes it magnetic again. In low manganese steels, i. e., when the manganese present does not exceed 3 or 4 per cent, high carbon injuriously affects the magnetic properties of the alloy; but in high manganese steels, i. e., when the quantity of manganese in the alloy is 10 per cent or over, increasing the carbon improves the magnetic properties of the alloy. The hardness of the manganese steels, as tested by the file, agrees precisely with their relative magnetic conditions. The very high remanence and coercive force, as well as the high value of the induction in a 7½ per cent tungsten steel, show that permanent magnets should be made of a steel containing from 5 to 7 per cent of tungsten. The effect of chromium is similar, but not so strong, yet when added as a third constituent to an alloy, the results are quite different with the two elements. The effect produced by the addition of a small quantity of a third element is very remarkable. Thus, high nickel steels are fairly magnetic, but when 5 per cent manganese is added, they become non-magnetic; although a 5 or even 8 per cent manganese steel is magnetic. When only 2½ of nickel are added to the latter, the alloy becomes non-magnetic, yet by itself a 2½ nickel iron is almost as magnetic as pure iron. These and other magnetic changes, such as the slight increase in magnetic susceptibility produced by the addition of copper, are no doubt largely due to the increased hardness or softness of the alloy thereby produced, mechanical and magnetic hardness going hand-in-hand. Of great importance is the promise

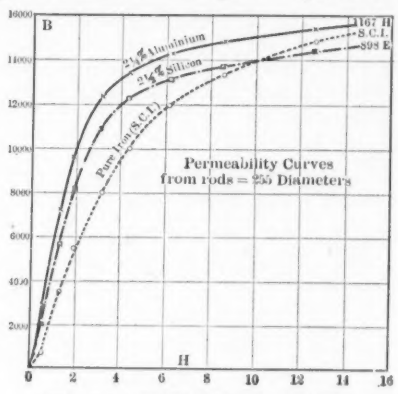


FIG. 2.—PERMEABILITY CURVES.

of a material for transformers which is better than the best soft iron. This is an iron containing 2½ per cent of silicon, which makes a soft and beautiful alloy, easily worked. It takes a good polish, but rusts more easily than pure iron. Even better is the alloy containing 2¼ per cent of aluminum. The results are given in the adjoining Fig. 2. With the aluminum alloy not only is the permeability greater, but the maximum induction in all fields up to about 60 units is also

greater than in any magnetic body yet known. From a theoretical point of view it is a very extraordinary fact that replacing the quantity of pure iron in a body by 2½ per cent of a non-magnetic body should so increase its magnetic qualities. The explanation suggested is that the addition of a small quantity of aluminum or silicon by combining with and removing any oxygen or oxide of iron in the molten metal leaves the granules of iron purer and of closer and finer texture than they otherwise would be. The conductivity of these alloys is poor; see, for instance, Fig. 1. In the discussion which followed, Lord Kelvin said that the increase of permeability produced by the addition of 2¼ per cent of aluminum was a magnificent result, and from that and the great reduction of retentivity it would be clear that this might be of great value in the use and manufacture of transformers. He asked for data regarding the amount of heat produced under alternating magnetization. Barrett gave the following data in which the first figure always refers to pure iron, the second to silicon iron, the third to aluminum iron; for $B = 9000$ the "watts per pound" 1.35, 0.98, 0.75; for $B = 4000$ the "watts per pound" 0.38, 0.27, 0.21; the Steinmetz coefficient 0.0011, 0.00078, 0.00059. Caldwell pointed out that the high resistivity of the aluminum alloy is a benefit as it will reduce the eddy currents and allow thicker sheets to be used in transformers. Barrett said that the question of ageing is still undecided.—Lond. *Elec. Times,* Feb. 20; more briefly, without illustration, in Lond. *Elec.,* Feb. 21.

Direct-Current Dynamo Design.—CLAYTON.—An article on direct-current dynamo design with regard to commutation. He criticises severely a rule, given recently by Kennedy, as was noticed in the Digest. He says that most designers have some rules to guide them in the right proportioning of field strength to armature strength, and he gives one. But he says that such rules have absolutely no bearing whatever upon the commutating qualities of the machine beyond preventing distortion of the field flux by armature reaction, and hence keeping the position of the brushes fixed during alteration of the load. He urges keeping the ratio value of the field ampere turns for gap and teeth to the armature ampere turns, fairly high. If it is desired to have no shifting of the brushes, it should not be less than 0.7 in large machines to 1 in small sizes. Many machines, especially traction generators, may be seen running in which the ratio is much less than the above, but such machines, although usually stated to require no shifting of the brushes, have a brush position for no load and one for full load. To produce the necessary ratio, a long air-gap with low density may be used or a short one with a high density. He believes, however, that a short gap with high density is preferable, as in such there is less liability of the flux being distorted by reason of armature reaction than in the long gap of low density. It must not be lost sight of, however, that with a short gap of high density, and highly magnetized teeth, one always runs the risk of inducing large eddy currents in the pole faces if the latter be of solid cast-steel, or even of cast iron. One must either laminate the pole-faces or else use partially closed slots, which eliminate these losses to a great extent, but both remedies mean extra expense in manufacture. With solid pole faces and open slots, short gaps can be used without incurring trouble from eddy current losses, by keeping a comparatively low density in the teeth and having many slots of small breadth instead of a small number of broad ones. The reason why highly magnetized teeth apparently help to improve commutation, is that they prevent distortion of the impressed flux. The cost of a machine for a given output and speed can be greatly reduced by using a high strength of armature as compared with field, and hence it is of the utmost importance to be able to use just the maximum without incurring any risk of bad commutation.—Lond. *Elec. Rev.,* Feb. 21.

Alternating-Current Machinery for High and Low Frequencies.—BEHREND.—The conclusion of his illustrated article. For higher speeds, the difficulties attendant upon the construction of 60-cycle, slow-speed generators, disappear, but the mechanical construction of the revolving fields for high peripheral speed requires much attention. He then discusses 25-cycle generators, and shows that they are considerably less expensive to build. He compares direct-current motors (which naturally operate at a low frequency) with high frequency motors. The data given by him show that the compact direct-current motor weighs about the same as the disk-like induction motor. The cost of material in both machines is approximately the same, but the total cost of the induction motor is higher, owing to the greater expense of machinery, winding and handling of the larger parts. It is perfectly possible to build rotary converters for 60 cycles, but, in the great majority of cases, the station engineer will prefer the motor generator on account of the smaller number of brush-studs with their brush-holders. In regard to efficiency and cost, the rotary converter is superior to the motor-generator. The 25-cycle system has a powerful ally in the rotary converter. The power plant and the whole electrical equipment, excepting the transformers, are more economical from an engineering and from a commercial point of view. The 25-cycle plant is thus extremely well adapted to the distribution of power and of light wherever three-wire direct-current systems may advantageously be installed. Series arc lighting has to be done by light dynamos driven by synchronous or induction motors for 25 cycles, or by frequency changers. The development of the series alternating-current arc systems is, at present, the mainstay of the 60-cycle systems, although incandescent lighting is not at all a negligent factor in determining the choice of the frequency. He believes that there will finally be a complete differentiation of the central station for the distribution of power, and of such for the distribution of light. The frequency of 20 or 25 cycles will be used for the power systems while the central stations for the distribution of electricity for lighting purposes will be operated at 60 cycles.—*Elec. Rev.,* Feb. 22.

Influence of Sub-station Equipment on Cost of Electricity Supply.—STEWART.—A part of a paper read before the Newcastle Local Section of the (Brit.) Inst. Elec. Eng. He gives detailed estimates as to the cost and efficiency of different equipments of sub-stations. He finally concludes that "taking everything into consideration, it is apparent that only the very strongest engineering reasons can justify the adoption of motor-generators in preference to rotary converters. Such disadvantages as the latter may have are not at all serious, and do not, in the writer's opinion, justify their exclusion from a distribution system under ordinary conditions." In his estimates he finds that the total capital outlay on a sub-station with non-synchronous or synchronous motor-generators is about 20 per cent higher than with three-phase rotary converters and almost 30 per cent higher than with six-phase rotary converters. At the same time the efficiency is about 6 per cent better for rotary converters, including statics, than for motor-generators.—Lond. *Elec.,* Feb. 21.

REFERENCE.

Troubles with Electric Machines.—SCHULZ.—A convenient summary, in the form of a table, of the different troubles which may occur in practice with direct-current and alternating-current machines (for instance, stray sparking at the brushes of a direct-current dynamo; an induction motor cannot be overloaded, etc., etc.). For each trouble in the columns of the table, the possible causes are given, with hints showing how to find them out and how to repair them.—*Elek. Anz.,* Feb. 16.

POWER.

Electricity in Mining.—GIBSON.—An illustrated article on the use of electric power for driving hoists, pumps, fans, drills, locomotives, etc. Brief descriptions are given of a larger number of installations. Incidentally it is said that induction motors are found most valuable in mines, as they are very simple in construction and require little or not attention. The conclusion is that while only a start comparatively speaking, has been made, the introduction of electric machinery is proceeding very rapidly. Indeed, the extent to which electricity is adopted corresponds very closely to the extent to which mine owners and managers become familiar with this new means at their disposal.—*Eng. and Min. Jour.,* March 1.

REFERENCES.

Hydraulic Equipment of the Colgate Power House.—BARBOUR.—A well illustrated description in detail of the Risdon tangential water-wheels and the Lombard governors, used at the Colgate power house.—*Jour. of Elec.,* Jan.

Electric Power in Cotton Mills.—WHALEY.—An illustrated article on electric power in American cotton mills, especially in the South. The well-known advantages of direct connected electric motor drive are discussed.—*Cassier's Mag.,* March.

TRACTION.

REFERENCES.

Telpherage.—CLIFT.—A well illustrated article on the principal features of construction and some of the uses of aerial telpherage.—*Cassier's Mag.,* March.

Chicago.—ELLICOTT.—A critical report by the city electrician of Chicago on the conditions of the electric surface street railways in that city.—*West. Elec.,* March 1.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Supply of Electricity in Bulk.—EARLE.—A paper read before the Manchester section of the (Brit.) Inst. Elec. Eng. He endeavors to show that the English power schemes cannot in any way be classed as speculative ventures. He gives an itemized estimate of the cost of installation, working cost, and revenues, for the Yorkshire Power Company, which is one of the proposed companies. It has four power stations scheduled, each of 25,000 hp, the three most important of which are situated on the coal fields and surrounded with factories and works of all descriptions, and with the exception of a small outlying portion of the area, 12 miles is practically the maximum distance to which it will be necessary to transmit energy. Of the total power 15 per cent is assumed to be used for traction, 60 per cent for motors, 25 per cent lighting. A load factor of 25 per cent is assumed. The calculations and estimates are given in great detail. The final result regarding the financial prospects is as follows: The total units per year sold equal 123,700,000, which at a charge of 2.2 cents per unit yields a revenue of $2,835,000; the annual expenditure is $1,588,750, leaving a profit of $1,246,250, which is equal to 4½ per cent on $3,333,330 debentures and 10.9 per cent on $10,000,000 shares capital. He, therefore, thinks that these British power schemes have a great future.—Lond. *Elec.*, Feb. 14.

WIRES, WIRING AND CONDUITS.

Fuse Wires.—MURDOCH.—A communication supplementary to the one noticed in the last Digest. He determined the time of fusing as a function of the current, No. 24 lead-tin wire of 3-inch length being used in all cases. With 6.32 amperes there was no fusion. The times in which the wire fused with 8.4, 12.25, 16.6 amperes were 28, 4.5, 2.1 seconds, respectively. The curve is of similar form to that obtained with constant current and variable length. It would be comparatively simple to design small fuses, so that they would, for a given current, "blow" after a definite time interval. At present almost any sort of length, size of terminals, wire, etc., is used for fuses. This may serve a useful purpose in the case of short circuit, but is frequently useless for cases where the current in a circuit rises to a dangerous extent through some defect.—Lond. *Elec.*, Feb. 21.

Insulation of Conductors of Electricity in India.—SCOTT.—MONCRIEFF.—A paper read before the Calcutta local section of the (Brit.) Inst. Elec. Eng. He first discusses the system of insulation for aerial conductors used by the Indian Telegraph Company, which is suitable for conductors weighing up to at least 1 lb. per yard run and for pressures up to at least 2300 volts. Vulcanized india rubber is a suitable covering for aerial lines. They have still to find out by experience the most suitable system of insulating underground conductors. House wiring, where there is any chance of dampness penetrating the cables, should not be done in wood casing. The climate of India is by no means a bad one for dynamos and motors. In fine wire coils surface leakage must be carefully guarded against. —*Jour. Inst. Elec. Eng.* (Brit.), Feb.

ELECTRO-PHYSICS AND MAGNETISM.

Thermo-Electric Force and Electric Resistance of Nickel, Iron and Copper.—HARRISON.—An illustrated account of an experimental investigation of the variation of the thermo e. m. f., and of the electric resistance of nickel, iron and copper, with the temperature between —200 degs. and + 1050 degs. The thermo-electric change in nickel-copper coincides approximately with the resistance change, but no thermo-electric peculiarity exists for iron-copper at the temperature of the Fe resistance change. As is shown by the Peltier coefficients, a marked change occurs at about 500 degs. in the case of Fe, Cu. This is approximately the temperature at which a flexure occurs in the copper resistance curve.—*Phil. Mag.*, Feb.

Conductivity of High Vacua.—STARK.—An article in which he first discusses the question whether the ether is an electrical conductor or not. According to modern views, a conductor is a body containing ions or electrons capable of free motion. The carriers of electricity are material particles, having a definite size and weight. If, therefore, the ether is regarded as an absolute vacuum, free from material particles, it must be an absolute non-conductor. If, on the other hand, our conception of the ether admits of the existence of ions within it, these ions will encounter no resistance in their motion, and the ether must, therefore, be a perfect conductor. The question thus becomes more a matter of definition than of fact. He applies the same reasoning to the highest vacua which we are at present able to attain and which cannot by any means be considered identical with pure ether. The probable strength of a current passing through a given vacuum is determined by the ionization, the gaseous pressure, and the distance between the electrodes. If the ionization in the gas is constant, the current increases as the pressure decreases, since the ions acquire a greater freedom of motion. But, as a rule, the ionization decreases as the pressure is diminished, for a gas absorbs less energy tending towards its ionization at a low pressure than it does at high pressure. To attain a strong current at a low pressure, a cathode with a large surface and a considerable distance from the wall of the tube must be used, since ionization goes on chiefly at the cathode. If, on the other hand, it is desired to have a small current, or to have cathode rays of high velocity, it is necessary to use a cathode of small surface, placed at a considerable distance from the anode and near the glass wall.—*Phys. Zeit.*, Jan. 15; abstracted in Lond. *Elec.*, Feb. 7.

Velocity of Ions Drawn from the Electric Arc.—CHILD.—A second article on this subject, at the end of which he gives the following summary: He compared the velocities of the positive and negative ions by four different methods. The first is a comparison of the average velocity of the positive with the average velocity of the negative ions. The second and third methods are comparisons of the most rapidly moving of the positive ions with the most rapidly moving of the negative ions. The fourth method is a comparison of the velocity of the slowest ions. In the comparison of the most rapidly moving ions and also in the comparison of the average velocities, the positive ions were found to have the greater velocity. In the comparison of the slowest ions little difference was found between the two kinds of ions. He thinks that these results are not in any way surprising. There is every reason to suppose that from anything as heterogeneous as the ordinary electric arc, many different kinds of ions are produced, so that among the positive ions there may be found the most rapidly moving and also the slowest. In this case the most rapidly moving ones appear to affect the average velocity so that it is greater than the average negative velocity.—*Phys. Rev.*, Feb.

Reflection of Cathode Rays.—STARK.—An article in which he gives a theoretical explanation of the reflection of cathode rays, based on the hypothesis that cathode rays consist of electrons, having a small mass in comparison with material molecules. For an electron, a metallic surface consists of a number of large particles irregularly distributed at intervals which are large compared with their size. When the electrons impinge upon such a surface, they either hit one of the front particles, or penetrate some distance behind the surface. There will be some force at play between the electrons and the molecules, and this force may be either gravitational or electrical. Whatever it is, it will tend to divert the electrons from their original path. The state of things will somewhat resemble that of a swarm of comets meeting a swarm of suns. Some of the comets will impinge upon the suns, and some will describe hyperbolic orbits about them. Some will penetrate far into the swarm of suns, and a few will penetrate the swarm altogether. But their path will have no direct relation with their original path. This is exactly what is known to happen in the case of cathode rays. He enumerates the known laws of the reflection of cathode rays, and finds some very remarkable and striking confirmations of his theory.—*Phys. Zeit.*, Jan. 15; abstracted in Lond. *Elec.*, Feb. 7.

Faults in Vacuum Tubes.—GOLDSTEIN.—A description of a simple method for detecting minute faults in vacuum tubes. He introduces a spark-gap of 12 mm. into the vacuum tube circuit, and then passes his fingers along the wall of the tube. Any fault in the glass is immediately indicated by a prickling sensation and a small spark is seen between the glass wall and the finger. The leak is cemented with gutta percha. If the prickling sensation is objected to, a separate vacuum tube may be used which carries a thin metallic plate attached to one of the electrodes. The sparks then pass to the other electrode which is held in the hand, and produce an optical effect of sufficient intensity.—*Phys. Zeit.*, June 15; abstracted in Lond. *Elec.*, Feb. 7.

Aurora.—STASSANO.—An article in which he brings out some relations between atmospheric pressure and the frequency of auroral display. Auroral maxima coincide with minima of barometric pressure in the upper atmosphere. A similar correspondence is seen in the annual and diurnal periods of the aurora. He believes that the aurora originates in the lower rather than the higher strata of the atmosphere.—*Comptes Rendus*, Jan. 13; abstracted in Lond. *Elec.*, Feb. 7.

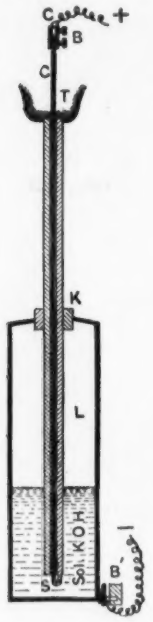
Electro-Chemistry and Batteries.

Artificial Graphite.—Fitzgerald.—An article on the Acheson process of making artificial graphite. In making graphite electrodes they are manufactured of petroleum coke and pitch like an ordinary carbon, such as is used in arc lights, but a certain amount of some carbide-forming material such as silica or iron oxide, is introduced. The electrodes are baked in the usual way, and are then ready for graphitization. To perform this operation they are placed in an electric furnace and heated to a temperature well above that of volatilization, of such bodies as iron, aluminum and silicon. In manufacturing graphite for other purposes, such as crucibles, paint, stove polish, etc., anthracite coal is usually employed. Artificial graphite electrodes are recommended for electrolytic and electro-metallurgical processes, and the advantages claimed for them are long life, low porosity, high conductivity and great economy.—*Eng. and Min. Jour.*, March 1.

Temperature Coefficient of the Daniell Cell.—Chandier.—An investigation of the temperature coefficient of the Daniell cell as a function of the concentration of the zinc sulphate, while the copper sulphate was always kept saturated. At extreme dilutions of the zinc sulphate, the temperature coefficient is negative, it becomes positive at a concentration of ½ per cent and negative again at a concentration lying between 7 and 8 per cent. The temperature coefficient is, therefore, zero at two different concentrations—at ½ per cent and at 7.5 per cent. The changes of temperature coefficient have their analogy in the amount of heat disengaged in the chemical reactions within the cell, and in the amount of e. m. f. itself. The former has a minimum at a concentration of 4 per cent, and the latter has a maximum at half of a per cent.—*Comptes Rendus*, Feb. 3; abstracted in Lond. *Elec.*, Feb. 21.

Units, Measurements and Instruments.

Carbon Electrolytic Interrupter.—A description of a new form of Wehnelt interrupter, shown in the adjoining diagram. It is recommended as a cheap, simple, self-adjusting instrument, well suited for continuous service. *C* is a carbon rod 3 mm. in diameter, and copper plated to within a few millimeters of the tip. This rod fits loosely in a "thistle-tube" *T*, which in turn fits the cork *K* of the lead jar *L* and dips into the electrolyte which is a solution of K O H. The end of the tube *T* has a little stirrup *S* drawn out on one side of it. Upon the point of this stirrup rests the carbon rod *C*. The copper plating, by increasing the conductivity of the rod, prevents excessive development of heat in it. As the rod wears away it slides down the tube and the copper wears off. The cork *K* has a small opening to allow the escape of gases. This interrupter is adapted for use with a 6-inch spark coil directly on a 100 to 110-volt direct-current or alternating-current circuit without the use of resistance in series. If some simple cooling device is used, such as immersing the jar in cold water. the jar may have a diameter of 2.7 cm. and may be 8 cm. high. To allow for automatic adjustment, the carbon rod fits the tube *T* rather loosely, and during operation the liquid is forced up into the bulb of the thistle tube until equilibrium is attained. The period of the interrupter may be varied by varying the depth of the solution. With a solution of one part concentrated K O H to four of water, this interrupter gives a current of 5 to 6 amperes on 100 volts with a 6-inch spark coil intended for use on an 8-inch circuit. By adjusting the stirrup *S*, or varying the size of the rod, an interrupter may be made to give almost any spark length up to the maximum which the secondary of the coil will stand. For use with X-ray tubes, direct current is preferable, but for many other purposes, as for wireless telegraphy, alternating current is preferable, because with it the interrupter works more evenly. This interrupter requires a minimum direct-current voltage of about 65 to 70 volts to give satisfactory results, and works best between 85 and 110 volts. With alternating current the minimum voltage is lower. One striking peculiarity is noticed when the interrupter is used on an alternating-current circuit, with an alternator and a direct-current ammeter in series. When the alternating current reads from 5 to 7 amperes the direct-current ammeter reads about 0.3 to 0.4 ampere. This is not accidental, but this excess current from the carbons to the lead seems to be due to the fact that the current is interrupted a less number of times in passing from carbon to lead than when passing from lead to carbon, for in the first case the break is probably caused mostly by the accumulation of oxygen on the anode, and in the second case mostly by the accumulation of hydrogen.—*Phys. Rev.*, Feb.



INTERRUPTER.

Wheatstone Bridge.—Gott.—A description of what he calls a perfect Wheatstone bridge. In the bridges as hitherto made the wire in each coil of the arms and variable resistance is made of the same alloy, so that it shall vary uniformly, and may be corrected approximately by observing the temperature of the coils. If, however, the set of ratio coils on the line side is made of wire whose resistance does not vary through the ordinary range of temperature, there will be no occasion to observe the temperature of the coils. The bridge becomes self-correcting, whatever be the alloy or metal of which the coils are made, so long as they are all of the same material, and this for any ratio of the arms. He uses a small box containing 10, 100, 1000 and 10,000 ohms of manganine. All the samples of "Eureka" wire which he has tested, vary oppositely to manganine with varying temperature, so that the coils made of the two alloys may be arranged to neutralize any variation. There are several useful purposes which these extra coils may serve. For example, if they are adjusted to standard ohms, a bridge in Brit. Ass'n units can at once be converted into standard units. Several other advantages are mentioned which he believes make the bridge especially valuable at cable stations and on board cable ships.—Lond. *Elec.*, Feb. 21.

Telegraphy. Telephony and Signals.

German-American Cable.—A full illustrated English translation of the German article on the new Emden-Fayal-New York cable, recently noticed in the Digest. There are also some critical editorial notes on it. Attention is called to the fact that the shore and cable on the American side is provided with a double core for a distance of 10 nautical miles, one of these cores forming the line connection, and the other being joined at its sea extremity to the inner side of the sheathing of the cable, thus providing an earth for the receiving apparatus 10 miles out at sea and effectually preventing any local disturbances from stray currents of electric railways. It is questioned whether the Harwood duplex system which is used at the Emden end of the cable is as good as Muirhead's double block system on long cables. First, on account of the difficulty in maintaining high insulation of the sending battery, which is essential for the duplex balance when the battery is placed in the cross-circuit, and, second, on account of the extra retardation introduced by earthing the battery through the artificial line. This latter arrangement has the effect of blunting the impressed wave to a very remarkable degree, with the result that the signals at the receiving end of the cable lack the definition which they possess on the true double-block system.—Lond. *Elec.*, Feb. 14.

Theory of Wireless Telegraphy.—Claude.—An abstract of a paper, read before the Int. Soc. of Elec. in Paris. He assumes a predominating influence for capacity between the antennæ combined with the conductance of the earth. He performed some experiments showing that conductance for high-frequency currents already exists for the earth itself, and that it becomes immensely greater for sea water, a fact which explains the higher efficiency of transmission on the sea. If no actual connection exists between the antennæ and the earth, he states that there is always a capacity which tends to act as an earth connection—either of a plate at the transmission antennæ, or the capacity of the receiving relay. He thus explains the increase in the distance overcome as a result of lengthening the antennæ and the corresponding increase of capacity. The same remark applies to the effect of increasing the diameter of antennæ, an increase which, moreover, attenuates the damping of oscillations. This latter effect is mostly interesting in syntonic telegraphy, which involves resonance phenomena requiring the minimum of damping action. He criticises Ferrie's statement that the length of antennæ should equal one-quarter the wave-length, and contends that these are absolutely independent of one another. In reply, Ferrie briefly expressed his doubts regarding Claude's theory and maintained his opinion regarding the relation between length of antennæ and wave-length.—Lond. *Elec.*, Feb. 14.

REFERENCE.

Wireless Telegraphy.—Ferrie.—His long illustrated paper in full on "The actual state of wireless telegraphy by means of Hertzian waves," an abstract of which was recently noticed in the Digest.—*Bull. de la Soc. Int. des Elec.*, Jan.

MISCELLANEOUS.

Lightning Photographs.—WALTER.—An account of experiments in which he photographed lightning flashes with a camera mounted on an inclined axis and revolved with a known speed. One of the photographs shows a flash whose entire duration was 0.15 seconds. It consisted of three separate flashes, with intervals of 0.041 and 0.11 second between them, respectively. Only the first flash shows any branches, probably due to pilot discharges. These confirm the author's view that the flash originates in a brush discharge of positive electricity which penetrates more and more towards the earth. The question of the oscillatory or intermittent character of lightning still remains open.—*Phys. Zeit.*, Jan. 15; abstracted in Lond. *Elec.*, Feb. 7.

REFERENCES.

Electric Furnaces.—The first part of an article giving brief illustrated descriptions of a large number of electric furnaces. Resistance furnaces are dealt with and the discussion of arc furnaces is begun.—*Elek. Anz.*, Feb. 9, 13, 20.

ARNOLD.—O'HARA.—A biographical sketch with a good portrait of Bion J. Arnold.—*Cassier's Mag.*, March.

New Books.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Twenty-fourth Convention, Niagara Falls, N. Y., May, 1901. New York: National Electric Light Association. 451 pages, illustrated.

The Report of the twenty-fourth convention of the National Electric Light Association forms a handsome volume of 451 pages. Two of the papers contained give it a permanent value, namely, the report of a Committee on Uniform Accounting, and Professor Matthews' report on the photometric value of arc lamps. The value of the latter, however, is much marred from the use of the Hefner unit. The report of the Committee on Uniform Accounting is of great value, as it contains a general outline of a system of accounting upon which there can be based a system for the smallest central station, as well as one for the largest.

LES TRAMWAYS ELECTRIQUES. By Henri Marechal. Paris: Ch. Beranger. 328 pages, 188 illustrations. Price, 10 francs.

This is the second edition, revised and considerably enlarged, of a book first printed some years ago. Of the 12 chapters of the book, seven are almost entirely descriptive. The first chapter treats of generalities and includes a section on the principles of polyphase currents. The second chapter is on the roadbed, and following chapters are on the overhead trolley system, underground contact systems, surface contact systems and storage battery systems. A chapter treats of the rolling stock, and another of the power house and car barns. Chapter IX. considers briefly the production, transmission and transformation of electricity. Chapter X. is on operation, Chapter XI. on finance, and the final chapter relates to French laws and regulations applying to the franchises and operation of electric railways. The portion of the book that will be found of most interest to the American reader consists of the chapters giving descriptions of a large number of underground and surface contact systems. Otherwise the book is rather sketchy in character, and has little or no engineering value.

THE ELEMENTS OF PHYSICAL CHEMISTRY. By Harry C. Jones. New York: The Macmillan Company. 565 pages, 67 illustrations. Price, $4.

Professor Jones is certainly a prolific writer. Hardly a year ago his "Electrolytic Dissociation Theory" appeared. Last November a second book of his, the "Elements of Electro-Chemistry," was published. Now we have a third and larger book of some 500 hundred pages, covering comprehensively the whole field of the shorter treatises. Such a Clyde Fitch rate of production can hardly be said to be beneficial to scientific accuracy. To borrow a electro-chemical metaphor, a heavy discharge rate decreases the efficiency of the output.

Marks of hasty work have certainly marred this book. To say nothing of errors in proof-reading, it would be no hard task to fill several columns with examples where Professor Jones has assumed on the part of his readers not only a knowledge of physics and chemistry, but also the ability to read between the lines, to find in the context what properly should be placed in the text. For instance, what is the use of stating in a didactic treatise the fact that the electrodes in the apparatus for measuring resistances of electrolytes should be platinized and not adding the reason for this procedure. In the chapter on electrolytic conduction, in the second class of conductors the Nernst filaments should be certainly included. Recent work on this subject has thrown a great deal of light on the very interesting subject of solid solutions.

As physics is the science of energy and chemistry the science of matter, we have a right to expect in a book on physical chemistry a great deal about energy and the energy-changes of matter, as well as the treatment of the changes of matter as affected by the different physical agents. A glance, however, at the index of this book shows under the heading of energy only one reference, viz., electrical energy. Compared with Nernst's "Theoretische Chemie," where the changes of electrical, thermal, photo-chemical energy into chemical energy, etc., have each their separate references, and where the subject is treated from the standpoint of thermodynamics, the American book, we very much regret to say, makes rather a poor showing.

Although the above criticism of the book on the ground of its being vitally deficient in neglecting the energy side of physical chemistry, as well as many minor details—especially the chapter on "Batteries in General Use," which should be especially full and up to date—yet the book does present some very commendable features as a brief for the dissociation theory of the present Ostwald's school of physical chemists. There is given from cover to cover a wealth of experimental evidence and proofs from this evidence of the substantial correctness of this theory, and as a skillful advocate Professor Jones does not gloss over some minor inconsistencies in his client's case, but exposes them, answers the objections when possible—even refutes many strong objections—explains away inconsistencies, and, in a word, minimizes its weakness as well as magnifies its strength.

Professor Jones brings out well the history of the rise of the new science in elaborating its present developed theory, shows the course of scientific evolution in eliminating the freak theories, but retaining their good qualities in their descendants of the day. The bones of the fossils of former ages help to fix in our minds the comparative morphology of the living animals. The numerous references and translations of the original memoirs emphasize this pleasing feature of the book. The language of the classic authors is often the best medium for disclosing the views held by them.

Then, too, it can be said that the book is up to date in many particulars, as, for instance, in the short account of J. J. Thomson's work on the "Electron Hypothesis." Taking it all in all, considering its merits as well as its demerits, Professor Jones' book is the best volume in English that treats on the subject of physical chemistry. Walker's "Introduction to Physical Chemistry" is too short and not comprehensive enough. Ostwald's "Lehrbuch" is too abridged in the English translation. Palmer has translated Nernst's great German work so inaccurately and imperfectly as to bar it out of any comparison. Accordingly, Professor Jones' book should be on the shelf of every chemist practical or theoretical who wishes to have at hand a book where the outlines of physical chemistry are printed in an available form in English.

BOOKS RECEIVED.

ELECTRICAL ENGINEERING TESTING. A Practical Work for Second and Third Year Students, Engineers and Others. By G. D. Aspinwall Parr. Philadelphia: J. B. Lippincott Company. 474 pages, 218 illustrations, 31 tables. Price, $3.50.

THE RÖNTGEN RAYS IN MEDICINE AND SURGERY. By Francis H. Williams, M. D. New York: The Macmillan Company. 658 pages, 390 illustrations. Price, $6.

Directory of Electrical Societies, Etc.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Chicago, June 18, 1902.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, September, 1902.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Quebec, June 11, 12 and 13, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, September, 1902.

NATIONAL ASSOCIATION OF MANUFACTURERS. Next meeting, Indianapolis, Ind., April 15, 16 and 17, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 25, 26 and 27.

OHIO STREET RAILWAY ASSOCIATION. Next meeting, June, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, October, 1902.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Next meeting, San Antonio, Tex., April 18-21, 1902.

Power Transmission in Mexico.

The fact that Mexico possesses many admirable water powers within striking distance of her mines and cities has led to considerable electric power development, and in a growing number of the plants use is made of American apparatus. One of the most interesting of these enterprises is that for which an American company has been formed, chiefly by New Yorkers, to utilize the concession and franchise for furnishing electric current in Toluca, capital of the State of Mexico, and in towns adjacent.

The Rossiter-MacGovern Company, of 141 Broadway, New York City, who have successfully financed and built several electric power plants in this country, secured this concession, and have charge of the erection of the plant. The concession covers two separate water powers, aggregating over 8000 hp. Construction was begun on the smaller plant and the work inaugurated with considerable ceremony by Governor Vincente Villada and other leading officials of the State of Mexico in person on Jan. 2, this year. The high price of oil in the locality has made the people very anxious to secure electric light, and the project is regarded with much favor locally.

The plant will have a nominal capacity of 1200 hp, and contracts have already been made for the furnishing of power and light equal to two-thirds of this. The plant was designed by Mr. Alex. Potter, electrical engineer, of 150 Nassau Street, who is in direct charge of construction. The plans have been approved by Mr. W. A. Brackenridge, of the Niagara Power Company. Counsel for the company is

FIG. 1.—SAN SIMONITE FALLS.

Mr. Henry W. Goodrich, of New York City, and its Mexican counsel is Senor Pablo Martinez Del Rio, one of the best known corporation lawyers in Mexico.

Contracts have been let for all the machinery required, and it is expected to have the plant in operation in July next. The Pelton Waterwheel Company are to furnish three 450-hp turbine wheels, together with the steel flume, receiver, etc. The Stanley Electric Manufacturing Company have the contract for three 325-kw generators and transforming apparatus and switchboard in the station, and the General Electric Company will furnish all sub-station apparatus, rotary converters, transformers, switchboard, together with some 300

FIG. 2.—VIEW OF TOLUCA.

of their newest type 1200-cp arc lamps. The Western Electric Company are furnishing some 200 miles of copper wire, and all line material, insulators, etc., together with a complete telephone outfit.

The transmission lines will carry 22,000 volts, at which voltage the power will be transmitted to Toluca, which is about 22 miles from the main station. Power and light will also be furnished to the municipalities of Tenancingo and Tenango, catering altogether to a population of over 100,000. The water of the stream for which power is depended on has its origin in the rain and snow from Toluca Mountain, and is practically constant during the year. Measurements and gauging, which have been in progress since 1895, show a flow of 650 liters or 23 cu. ft. per second, and a fall of 720 ft. in 6000 ft.

The necessary capital required has been furnished by a syndicate, and upon completion of the plant it will be turned over to the Toluca Electric Light & Power Company, a corporation to be formed under the laws of the State of New York. The principal owners include Senator Chauncey M. Depew, W. W. Goodrich, H. C. M. Ingraham, E. V. W. Rossiter, D. H. Valentine, J. L. Greatsinger, T. S. Williams, C. L. Rossiter, H. C. Du Val and John R. Christie, many of whom are well-known in American electrical and traction work.

Small Plant Switchboards.

The General Electric Company now offers a complete line of standard small plant switchboards manufactured in a variety of capacities.

FIG. 1.—SWITCH.

The designs include a complete series of combination generator and feeder panels for low-potential direct-current small plant service. Each of these panels is a complete standard switchboard and is not intended for combination with other panels. The care used in de-

termining just what features should be embodied in panels of this type in order to make them serviceable in the largest number of cases, has resulted in a design embodying standard and finish and efficiency, and which can be produced at a reasonable figure in such quantities that orders may be promptly filled. These small plant switchboards are uniformly made to provide for one generator and two feeder circuits. The material used in the construction of these switchboards is black enameled slate, 1½-inch thick, selected with reference to freedom from impurities. After being baked perfectly dry, the slate is covered with enamel, each layer being baked on and rubbed down, the final hand polish resulting in a hard, brilliant surface. The height of the slate panel is 36 inches for all capacities, the width varying from 16 inches to 20 inches, depending upon the capacity. All exposed metal parts on the front of the board, except live copper, have black oxidized finish.

Two methods of support are manufactured, either of which is supplied according to the requirements. One is known as the angle iron support, the other the bracket support. In the first method, the panel

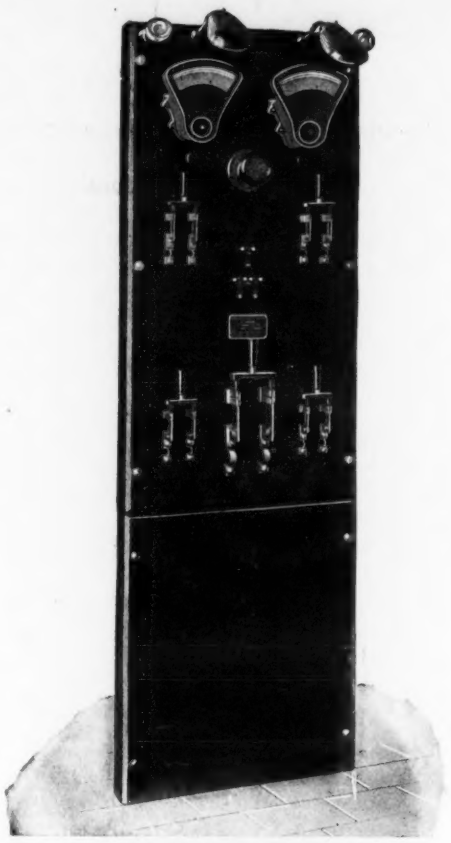


FIG. 2.—SWITCHBOARD PANEL.

is supported on angle irons 40 inches from the floor, the angle iron being provided with turn buckles and clevises for making wall attachment. In the second method, the panels are secured to the wall by bracket supports independent of the floor.

On these switchboards a General Electric lever switch is used, which conforms with the underwriters' requirements, and has solid forged copper clip blocks and studs. Blades are rigidly fastened to the cross-bars. The blades, clip blocks and stubs are all given a ground finish. The handles of the switches are of hardwood, finished black. All switches are provided with fuses.

On these panels, the ammeter is permanently connected in the generator circuit. The instrument is the company's round dial indicator, which is particularly adapted for long continued hard service. Its few parts are strongly constructed, and having no springs, it is particularly free from liability to change.

Magnetic Traction Device.

The Acme Magnetic Traction Company recently made tests of a magnetic device with a 35-ft. electric street car, in the car barn of the Jackson Street line, Seattle, Wash. The device tested consists essentially of a coil of insulated wire wound around the axle of each pair of driving wheels, the axle and wheels forming a horseshoe magnet, and the rails corresponding to the armature. When the current is turned on, the wheels grip the rails with great force. The increased hold on the track adds greatly to the pulling power of the car, magnetic adhesion taking the place of increased dead weight to increase the traction. The claims for this device are that it prevents slipping of the wheels of cars or locomotives, and in ascending grades it is only necessary to control the revolutions of the wheels by increasing the tractive force, and in descending to apply the ordinary brake pressure. About 3½ per cent of the current required to operate an electric car is needed to energize the magnets.

In the Seattle tests, the two motors were of 40 hp each. The car was connected by a cable to a dynamometer, which indicated the tractive power of the motors. Without the use of the magnet arrangement the dynamometer showed a draw-bar pull of less than half a ton, and the wheels slipped on the rails. With the magnetic device in operation, the pull jumped to more than two tons, the increase in traction thus being over 300 per cent.

An improved magnetic device for the same purpose will soon be tested by the Company on street cars and locomotives. In this type, instead of the drive wheels being used as magnetic poles, the coils are wound on the axle connecting two small wheels, about a foot in diameter, running on the rails as close as possible to the driving wheels of the car or locomotive.

By this method the magnetic circuit is closed through the rails, drive wheels and axles. In practice, a pair of these auxiliary wheels is placed at each end of the car, close to the outside pair of car wheels. Mr. A. A. Honey is the inventor, and the company's main office is in Tacoma, Wash.

A New Therapeutical Journal.

The title of a magazine just started in New York is the *Journal of Advanced Therapeutics*. This journal is the outcome of a combination of *The Journal of Electro-Therapeutics* and the New York *Lancet*. Its scope is actually much wider than that of either of the two journals mentioned. It will be devoted very largely to the various applications of electricity in therapy and diagnosis. Besides electro-therapeutics, various special branches will be covered, including radiography, thermo-therapeutics, hydro-therapeutics, climatology, therapeutic exercise, photo-therapy and dietetics. The journal is edited by Dr. William Benham Snow. Among the associate editors are G. Betton Massey, M. D., Philadelphia; Mary L. H. Arnold-Snow, M. D., New York; Francis H. Bishop, M. D., Washington, D. C.; Walter H. White, M. D., Boston; Robert Newman, M. D., New York; J. D. Gibson, M. D., Birmingham, Ala.; Clarence Edward Skinner, M. D., LL.D., New Haven; W. Scheppegrell, M. D., New Orleans. Dr. Snow will have the advantage of the collaboration of some of the most eminent practitioners in the profession. Among these are Drs. W. J. Morton, Max Einhorn, A. D. Rockwell, Margaret A. Cleaves, J. Edward Stubbert, Carl Beck, L. A. Weigel, Robert Reyburn, G. F. Hanson, Albert Abrams and Lucy Hall-Brown.

The first number, that for January, 1902, contains some able articles, and the general treatment of these would seem to give encouraging promise of an increasingly higher standard of technical accuracy and scientific dosage. There has unfortunately been associated with the study and practice of electro-therapeutics a great deal of empiricism, inaccuracy and uncertainty. This has inevitably been a source of reproach to the profession, and has created a great deal of distrust and prejudice. The advent of this new journal, however, as has been stated, would appear to justify the belief that a new era is dawning in the domain of this important branch of therapy. The purpose evidenced in its pages is to combine the kindred therapeutic measures in such a manner, as not only to break down the prejudice above-mentioned, but to show that the electro-therapeutist recognizes the value and necessity of other enlightened measures in conjunction with his own. The January number embraces special articles on the following subjects: "A Case of Rectal Stricture Treated by Electrolysis," by Dr. Walter H. White; "Treatment of Urethral Strictures by Electrolysis," by Dr. Robert Newman; "The Use of Electricity in Renal Disease," by Dr. A. D. Rockwell; "A Study in Contemporary Gynecology," by Dr. G. Betton Massey; "Therapeutics of Dry Hot Air," by Dr. Clarence Edward Skinner.

One of the most interesting articles in this edition is that on "Dermatology," in which the successful treatment of lupus and

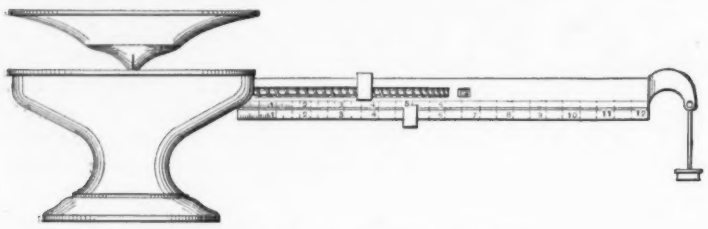
cancer by means of Röntgen rays comes in for special notice. Successful as has been the treatment of these diseases by the filtering of the rays of the arc light through quartz lenses, it is now generally recognized that Röntgen rays are likely to be the media of such treatment in future as being quicker, less expensive and more effective. Among the other branches covered are electrical applications in affections of the eye, ear, nose and throat, genito-urinary and constitutional diseases and the alimentary canal; also of therapeutics of dry hot air, skiagraphy, orthopedics, hydropathy, therapeutic exercises, dietetics, climatology, etc. This journal is the official organ of the Electro-Therapeutic Association, and is intended also to serve as a record of the meetings and transactions of the various scientific and kindred associations.

Weighing and Counting Machine.

In all large factories where punch press, screw machine, or small work of any kind is made or used to any extent, as in many electrical works, it is now necessary to employ a number of boys or girls to count this material that shop records may be kept up to modern standards. The cost of this continued but necessary handling is evidently overlooked by many concerns, and by others, simply regretted and classed as an unavoidable expense. To reduce to a minimum this important factor in shop costs is the object of a weighing and counting machine recently patented by Joseph S. Cortelyou, of New York City.

This device, the operation of which is based on well-known laws of the lever and fulcrum, provides a scale in which the point of application of the weight as well as that of the force, is made variable at will, thus increasing the range of the scale when weighing, and making it possible to obtain readings in any and all systems such as avoirdupois, troy, metric, etc., by the simple turn of a milled head. When used for counting material, it is only necessary to set the scale for that material by a turn of the same milled head, then proceed as in weighing and the scale will indicate the number of pieces instead of pounds or ounces.

We illustrate herewith a small scoop scale which weighs to 25 lbs. avoirdupois or its equivalent in any system, and counts to 5000. Referring to the cut, it will be seen that in general appearance the scale is similar to the ordinary weighing scale, but provided with a longi-



WEIGHING AND COUNTING MACHINE.

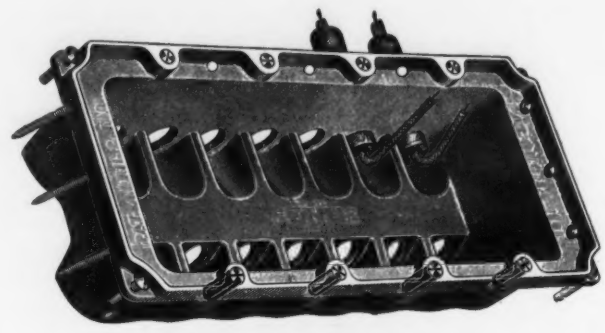
tudinal slot in the bar or beam in which a long screw having a right-hand thread on one end and a left-hand thread on the other, is placed and controlled by a milled nut on one end. The carriage supporting the pan is carried to or from the fulcrum as required for the different systems by the screw and is always counterbalanced by the weight on the other or outer end of this screw.

A series of graduations corresponding to the various systems and a scale of numbers from 1 to 5000 are laid out on the bar, from which the readings are taken. On the top of the frame through which the pan support projects, are arranged the index marks which show the proper position of the support for each of the different systems.

Combination Switch-Box.

We illustrate herewith a four-gang combination switch box, known as the Renim type, the name implying that this box may be used equally well for either "old" or "new" work. This is accomplished by the peculiar arrangement of the pockets, all of which face in the same general direction. The boxes are provided with four leveling screws, as shown in the cut, and are attached directly to the lath or other woodwork entirely independent of the plastering. The leveling screws are used for bringing the front edges of the box into the same plane with the plaster surface. When the attaching screws, which are drilled on an angle, are inserted, the box is fastened in such a manner as to be impossible to work loose from the constant jar caused by the operation of the switch.

This box is also provided with the same universal adjusting feature used by the same makers in their "universal" switch box, the



COMBINATION SWITCH BOX.

same box taking different makes of switches of the same type. It does not require a back plate, as each switch is attached directly to the box and may be adjusted independently. No special switch is required for gangs, the ordinary switches being used, thus greatly simplifying the "gang switch" problem. These boxes are manufactured by the Renim Specialty Company, 176 Federal Street, Boston, Mass.

Chicago Automobile Show.

The Chicago automobile show held in Chicago last week was an occasion for the formation of a national organization to be known as the "American Automobile Association." The membership in this national association will consist of clubs. Each club pays an entrance fee of $10, and the annual dues are to be $3 per capita for each member. The meetings are to be held each spring, alternating in the East and in the West. Five clubs will constitute a quorum. The following officers were elected: President, Winthrop E. Scarritt, Automobile Club of America; first vice-president, Frederick C. Donald, Chicago Automobile Club; second vice-president, W. W. Grant, Long Island Automobile Club; third vice-president, W. G. Morris, Automobile Club, of Philadelphia; treasurer, Jefferson Seligman, Automobile Club of America; secretary, S. M. Butler, Automobile Club of America. Directors: Officers and F. G. Webb and A. R. Pardington, Long Island Automobile Club; A. R. Shattuck, Automobile Club of America; W. J. Stewart, New Jersey Automobile Club; F. C. Lewin, Automobile Club, of Philadelphia; Dr. Chase, Automobile Club of Rhode Island, and the president of the Utica club.

The clubs represented at the Chicago meeting were the New Jersey, the Long Island, the Chicago, the New York, the Rhode Island, the Philadelphia, the Utica and the Grand Rapids.

The American Motor League also held a meeting at the same time and elected the following officers: President, Edwin F. Brown, Chicago; vice-presidents, C. E. Duryea, Reading, Pa.; Grant W. Murray, Detroit; S. Wallace Merryhew, New York; secretary, F. A. Fagan, New York; treasurer, F. B. Hill, Boston.

The show was well attended, both by manufacturers and visitors. Among the principal exhibitors of electric carriages were the Buffalo Electric Carriage Company, of Buffalo, N. Y., the Fanning Manufacturing Company, of Chicago; the Baker Motor Vehicle Company, of Cleveland, Ohio; the Waverly vehicles made by the International Motor Car Company; the National Vehicle Company, of Indianapolis; the Electric Vehicle Company, of Hartford, Conn., and the Porter Battery Company, of Chicago. Electric igniting apparatus for gasoline vehicles was shown by the Miller-Knoblock Electric Manufacturing Company, of South Bend, Ind.; the Everett Electric Company, of Indianapolis, Ind., and the Motsinger Device Manufacturing Company, of Pendleton, Ind. The National Carbon Company had a handsome exhibit of its batteries, especially suited for gas engine ignition. The only distinct exhibit of automobile storage batteries was made by the Porter Battery Company.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There has been a fairly good demand for money, with no diminution in the volume of loanable funds. The closing rates were 3½ per cent for 30 days, 4@4½ per cent for 60 to 90 days, and four, five and six months. In the stock market restricted activity continued owing to the heavy gold shipments and uncertainty as to the money market and the Northern Securities deal. Investment demands were large, bonds being firm, and high-priced dividend stocks showed a decided appreciation. Public interest in speculation, however, continues at a low ebb. The steel stocks were, on the whole, well supported and strong throughout the week. In the electric list General Electric was extremely strong on limited transactions, there being renewed reports that a stock dividend would soon be declared. The highest figure on record for this stock was reached on Thursday, when it was quoted at 302. The price fluctuated between this and 296, the stock closing at 299½, a net gain of 4½ points as compared with the closing price of the week previous. The total number of shares sold was 8900. In Boston, General Electric made an advance of 2¾ points. Western Union made a net gain of ½ point, closing at 91. Westinghouse Electric, common, showed considerable activity, 7900 shares having been sold at prices ranging from 178 to 185, the closing rate being 184½, which is a net gain of 6½ points. Westinghouse, 1st pfd., closed at 182. Quietness prevailed in Brooklyn Rapid Transit, and the quotations kept within narrow limits, the closing price being 64. Metropolitan Street Railway was also comparatively inactive and closed with a net loss of ¾ point, the last quotation of the week being 168. This stock fluctuated between 166¾ and 169¼, 20,500 shares having been sold. Manhattan Elevated was quiet, closing at 131, being a net loss of 1½ points. American Telephone & Telegraph made a net gain of 3⅜ points in Boston during the week. Following are the closing quotations of March 11:

NEW YORK.

	Mar. 4.	Mar. 11.		Mar. 4.	Mar. 11.
American Tel. & Cable	—	80	General Electric	296	299½
American Dist. Tel	—	30	General Carriage	1⅛	¾
Brooklyn Rapid Transit	63⅜	63⅜	Hudson River Tel.	—	—
Ches. & Pot. Telephone	—	—	Metropolitan Street Ry.	167⅛	167
Commercial Cable	—	150	N. E. Elec. Veh. Tran.	½	⅝
Electric Boat	28½	28	N. Y. Elec. Veh. Tran.	13⅜	13
Electric Boat pfd	45	45	N. Y. & N. J. Tel.	—	—
Electric Lead Reduc'n	1⅞	1⅞	Tel. & Tel. Co. America	—	—
Electric Vehicle	2⅛	2¼	Western Union Tel.	90¼	90½
Electric Vehicle pfd	4½	4¼	West. E. & M. Co.	178	181
			West. E. & M. Co. pfd.	180	185

BOSTON.

	Mar. 4.	Mar. 11.		Mar. 4.	Mar. 11.
Am. Tel. & Tel.	156	162	Mexican Telephone	2½	2¼
Cumberland Telephone	—	—	New England Telephone	140	140
Edison Elec. Illum.	—	—	Westinghouse Elec.	90*	—
Erie Telephone	—	—	Westinghouse Elec. pfd.	90	—
General Electric pfd	—	—			

PHILADELPHIA.

	Mar. 4.	Mar. 11.		Mar. 4.	Mar. 11.
American Railways	—	—	Phila. Traction	100	98
Electric Storage Battery	—	60	Philadelphia Electric	5½	5¼
Elec. Storage Batt'y pfd.	—	60	Pa. Electric Vehicle	—	—
Elec. Co. of America	6⅞	—	Pa. Elec. Veh. pfd.	3	—

CHICAGO.

	Mar. 4.	Mar. 11.		Mar. 4.	Mar. 11.
Central Union Telephone	—	—	National Carbon pfd.	84½	84½
Chicago Edison	—	175*	Northwest Elev. com.	39	38½
Chicago City Ry.	215	215	Union Traction	14⅞	15
Chicago Telep. Co.	—	175	Union Traction pfd.	50½	48½
National Carbon	20⅜	19¾			

*Asked.

DIVIDENDS.—The Commercial Cable directors have declared the regular quarterly dividend of 1¾ per cent. A dividend of $1.50 per share on its preferred stock has been declared by the Savannah Electric Company out of the earnings of the company since Jan. 1, 1902, payable April 1. The Twin City Rapid Transit directors have declared the regular quarterly dividend of 1¾ per cent, payable April 1. Directors of the Chicago Telephone Company have declared a quarterly dividend of 2½ per cent. This is a reduction from 3 per cent, which was made in view of the increase in taxes. The capital stock of the company is to be increased $3,000,000. In accordance with the provisions of the lease of the West End Street Railway Company to the Boston Elevated Railway Company, a dividend rental of $1.75 per share will be paid to holders of record of the common stock of the West End Company on April 1. The Otis Elevator directors have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable April 15. Manhattan Elevated directors have declared the regular quarterly dividend of 1 per cent, payable April 1. The executive committee of the Western Union Telegraph Company has recommended the declaration of the regular quarterly dividend of 1¼ per cent. Directors of General Electric have declared the regular quarterly dividend of 2 per cent on the common stock, payable April 15 to stock of record March 22.

STORAGE BATTERY OUTLOOK.—It is noted in advices from Philadelphia that before the Electric Storage Battery Company changed the time for holding its annual meeting from June to the month of March the management used to make about this date a preliminary statement of the financial results for the fiscal year ending Dec. 31. Now that the stockholders do not have to wait six months to learn of the operations of their company, no advance statement is given out. At the stockholders' meeting to be held March 19 the report for 1901 will show, it is said, gross earnings about equaling, but a trifle less, than those for the preceding year, when they reached $3,309,443. As the ratio of expenses runs about the same, it is expected that when the accounts are finally made up the net profits will also be about on a par with those for 1900. In that year they amounted to $1,317,865, or 7.8 per cent on the $16,875,000 share capital outstanding. These results, however, included $168,105 profits from the sales of securities. The company is paying regular dividends at the rate of 5 per cent per annum on both classes of stock, preferred and common. Since the first of the year, 1902, the company's business has been very favorable, and is stated to show up very flatteringly in comparison with corresponding periods of previous years.

SUBMARINE CABLE VALUES.—Discussing Mr. G. G. Ward's Commercial Cable report and his conservative but cheerful views as to the value of cable stocks, the *New York Herald* says: It is not the more or less successful transmission of letters across the Atlantic, or the somewhat unreliable service now existing between a floating lightship and passing vessels that will "convert submarine cables into scrap iron." It is for these reasons that the *Herald* congratulates Mr. Ward in the name of the public and in that of common sense. If a little of the latter be used the folly of the anxiety that of late has seemed to possess investors in submarine cable stock becomes apparent. The failure of the Marconi Honolulu Wireless Telegraphy Company shows the present practical inadequacy of wireless systems for commercial purposes. The public may take heart. There are still some years of very respectable dividends before those investors who have souls above 2½ per cent British consols or 3 per cent to 4 per cent railway stock, and who have placed their capital in submarine cable stock.

CLEVELAND TROLLEYS.—The *Plain Dealer*, of Cleveland, says that terms have been agreed upon for the consolidation of the Cleveland Electric Railway Company and the Cleveland City Railway Company, the two roads to be under the presidency of Senator Hanna. The consolidated company will include every street car line in the city, under the name of the Cleveland Electric Railway Company. Involved in the deal are arrangements for improvements, in transfers, and in all probability for the sale of six tickets for 25 cents. Stock to the value of $21,600,000 is involved, of which $13,000,000 represents the Cleveland Electric Company and $8,600,000 the stock of the Cleveland City Railway Company. All the Cleveland Electric Railway Company stock is to go into the general pool at $80 a share, the Cleveland City Railway Company to go in at $120 a share, or the Cleveland Electric Railway Company will go in at $100 a share, while the Cleveland City Railway Company will go in at $140 a share.

SAN FRANCISCO TROLLEYS.—According to Brown Brothers & Co., the plan for the merging of the electric roads of San Francisco includes the following properties: Market Street Railway, total mileage 183 miles, cars 766, capital stock $18,750,000, and funded debt $12,074,000; San Francisco & San Mateo Railway Company, mileage 30 miles, cars about 70, capital stock $1,000,000, no debt; Sutter Street, mileage 12.8 miles, cars 50, capital stock $2,000,000, funded debt $1,000,000; and Sutro Railroad, mileage 10 miles, cars 26, capital stock $400,000, no debt. The company to take over these properties is at the present time in process of formation, but particulars are not forthcoming.

ST. LOUIS TROLLEYS.—The arrangement by which E. W. Clark & Co., of Philadelphia, have secured the Eads Bridge Electric Railway and the St. Louis & Belleville Company's line from East St. Louis to Belleville, the electric roads of Belleville, and the Terminal Association's lines in East St. Louis involves an investment of $4,000,000, by which 125 miles of single track are acquired. The new owners will spend $1,000,000 in improvements, including additional power houses and equipment. A feature of the negotiation is that the syndicate has secured a 50-year lease on the Eads Bridge, and will widen the bridge to relieve congestion of traffic.

BELL TELEPHONE MOVES.—A special dispatch from Boston says: The recent visit of President Sabin, of the Central Union Telephone Company, to Boston and the appearance here of President Burt, of the Missouri-Kansas Company; President Yost, of the Nebraska Company, and President Caldwell, of the Cumberland Company, has given rise to a rumor that the subsidiary companies of the Western Telephone Company are to have placed at their head some of the above-named gentlemen. President Fish, of the American Telephone & Telegraph Company, believes that the property is too extensive and scattered to be managed by one president over all. It is probable President Sabin, of Chicago, will go to the head of the Cleveland and Michigan companies; President Yost, of Omaha, at the head of the Northwestern & Wisconsin companies, with either President Burt, of Kansas City, or President Caldwell, of Nashville, at the head of the Southwestern Company. This is a step toward the ultimate amalgamation of all the companies in the Middle West, with the new Western company. Before the close of the year, Chicago Central Union, Cumberland & Missouri and Kansas and the Nebraska Company may come into the Western Company under another plan of reorganization.

N. Y. & N. J. TUNNEL COMPANY.—According to a prospectus issued by the recently incorporated New York & New Jersey Railroad Company, whose object is to complete the half-finished North River tunnel, the officers of the company are as follows: William G. McAdoo, president; Walter G. Oakman, president of the Guaranty Trust Company, and Edmund C. Converse, former president of the National Tube Company, vice-presidents; Henry A. Murray, treasurer; Charles W. King, secretary, and Charles M. Jacobs, chief engineer. The directors, besides Mr. Oakman, Mr. Converse, and Mr. McAdoo, are: Elbert H. Gary, chairman of the executive committee of the United States Steel Corporation; John Skelton Williams, president of the Seaboard Air Line Railway; Anthony N. Brady, chairman of the Board of the Brooklyn Rapid Transit Company; E. F. C. Young, president of the North Jersey Street Railway Company; David Young, president of the Jersey City, Hoboken & Paterson Street Railway Company; John G. McCullough, of Vermont, director of the Erie Railroad Company; Frederic B. Jennings, of the law firm of Stetson, Jennings & Russell; G. Tracy Rogers, president of the Street Railway Association of the State of New York.

CANADIAN GENERAL ELECTRIC.—The statement presented at the annual meeting of the Canadian General Electric Company, held recently at Toronto, Ont., shows that the volume of business transacted during the past year, had been very much greater than any preceding one, and also that the current year commenced with more orders on hand than at the beginning of any previous year. The balance to credit of profit and loss amounted to $612,028, which is made up of $345,990 profit on operating (being an advance of 30 per cent over the year previous); $195,000 premium on new shares issued, and $71,038 brought forward. From this amount, dividends of 10 per cent on the common stock and 6 per cent on the preferred stock, amounting to $166,750, were paid. The sum of $167,596 was written off patents, plant, etc. It was also decided to apply to Dominion Parliament for authority to increase the capital stock of the company from $2,000,000 to $3,000,000.

NEW YORK & NEW JERSEY TELEPHONE.—The balance sheet of the New York & New Jersey Telephone Company (Bell) shows: Assets—Plant, $8,316,331; equipment, $1,292,325; real estate, $1,080,473; material and supplies, $462,961; accounts receivable, $789,826; treasury stock, $165,600; stocks and bonds, $422,490; cash, $857,028; total, $13,987,037. Liabilities—Capital stock, $9,540,000; general mortgage bonds, $1,324,000; real estate mortgages, $111,500; vouchers and accounts payable, $245,606; reserves, $162,936; dividend payable Jan. 15, 1902, $234,375; surplus Dec. 31, 1901, $2,368,019; total, $13,987,037.

TELEPHONY IN RUSSIA.—Advices from St. Petersburg say: Mr. H. T. Cedergren, of Stockholm, heads the syndicate of telephone men that purchased the plants of the International Bell Telephone Company, of Moscow and Warsaw. Previous to the sale of their properties in this city, the International Bell Company had over $1,000,000 cash in its treasury, and will make a handsome cash distribution to its stockholders in addition to large dividends that have been paid during the 20 or more years of its existence. The European headquarters of the company are at Antwerp.

PROVIDENCE ELECTRIC CONSOLIDATION.—The largest combination of commercial interests to occur in Rhode Island has been announced. It calls for the merger of the United Traction, capitalized at $8,400,000; Providence Gas Company, with $5,000,000 in stock, and the Narragansett Electric Lighting companies, capitalized at $2,750,000. United States Senator Nelson W. Aldrich, the president of the Union Traction Company, is working over the preliminary plan of forming the new company, the capitalization of which is not yet made public.

BELL TELEPHONE.—Rumors relating to a prospective stock issue by the American Telephone & Telegraph as a basis for the advance in price of stock are said to be premature. It is known that the company will be obliged to call, before the close of year, for new money to meet extensions and acquire its proportion of new stock issued by its sub-companies, but it is not believed that this new stock issue will come before July. The company is now said to be in unusually good financial condition.

UNITED ELECTRIC SECURITIES COMPANIES, of Boston, show for the year ending Feb. 28 a total income of $325,089, a net profit of $178,335, dividends of $70,000, and a total surplus to date of $385,998, or $110,066 more than last year.

Commercial Intelligence.

THE WEEK IN TRADE.—The mercantile agencies report that spring trade increases, notwithstanding the serious interruptions in some sections by floods and snowstorms, which restricted telegraphic and mail facilities and crippled railroads. All signs favor the indication that legitimate trade and industry is, except in a few instances, considerably more active than a year ago at this time. Although there is less apparent tension in iron and steel, the situation is a remarkable one. Floods and high water have interfered with production, limiting supplies of fuel, hampering productive operations and checking shipments. Finished products are active. Hardware is active at all markets. The interruption to coal production and shipments has caused some anxiety, but the advanced stage of the season prevents danger of small stocks being unduly shortened. Unprecedented activity is looked for in building lines this year, and all classes of this material are firmer in price. Copper was dull and uninteresting, and without any special feature; exports continued on a large scale. There was very little disposition to buy, while holders showed considerable willingness to sell. The closing quotations are 12¼@12½c. for Lake, 12@12⅛c. for electrolytic in ingots, cakes and wire bars, 11¾ and 11⅞c. in cathodes, and 12@12⅛c. for casting stock. The number of failures for the week ending March 7, as reported by *Bradstreet's*, aggregated 178 as against 204 the week previous and 208 the same week last year.

THE HAINES & NOYES COMPANY, Chicago, through its private telephone plant department, has closed the following contracts during the past month: Hotel Fremont, California, 130-drop switchboard and 130 telephones; Conservative Life Building, Los Angeles, Calif., 90-drop switchboard and 90 telephones; a large apartment building in Evanston, Ill., 35 telephones, and an apartment telephone system; the New High School, Chicago, 25-drop switchboard and 25 telephones; Messrs. Marsh & Uhlmann, Chicago, inter-communicating system of 17 hand microphones; the Globe-Wernicke Company, Chicago, a large inter-communicating system. Through the company's agents in Los Angeles, Calif., the Woodhill & Hulse Electric Company, 20 inter-communicating systems have been installed in Los Angeles and surrounding territory; and through the John M. Klein Electric Company, San Francisco, a 36-telephone system has been sold to the United States Government, for the Navy Yard, Puget Sound. The home office of the Haines & Noyes Company has closed contracts for 10 apartment telephone systems in Chicago. The company is also equipping the St. Anthony's Hospital with house telephones, also the J. S. Ford-Johnson chair factory, Michigan City, Ind.

ELECTRICALLY-DRIVEN MACHINE TOOLS FOR MEXICO.—The Compania Fundidora de Fierro y Acero de Monterey (the Monterey Iron & Steel Foundry Company, of Monterey, Mexico), of which concern Mr. Robert Meehan is president, is now placing some substantial contracts in this market for various equipment to be installed in the extension of its works, it having decided to enter into the manufacture of gasoline engines on an extensive scale. The additions to the existing plant will mean an expenditure of some $200,000. Everything in the shape of equipment is to be purchased in the United States. Manning, Maxwell & Moore, of 85-89 Liberty Street, New York City, have been allotted a contract for three large punching and shearing machines, to be built by the Hilles & Jones Company. The same Liberty Street concern has obtained an order for three rail drilling equipments by the Newton Machine Tool Company. These tools will all be electrically driven. The motors varying from 10-15 hp, are to be furnished by the General Electric Company.

BATTERY FOR EASTON, PA.—The Gould Storage Battery Company, of Astor Court Building, New York City, has just completed the installation at Easton, Pa., of a battery plant for the Easton Power Company, which is one of the properties of the Light, Heat & Power Corporation, of Boston. This plant consists of 255 cells of the Gould battery in lead-lined tanks, having a capacity of 408 kw-hours, and has a Gould patented C. E. M. F. regulating booster. This equipment is to be used in regulating the fluctuations of the street railway load, and replaces an equipment of half its size.

GOUDEY-M'LEAN CONNECTIONS ABROAD.—The Goudey-McLean Company, of 88 Maiden Lane, New York City, recently established for the purpose of acting as manager for foreign sales of a syndicate of manufacturers of electrical apparatus and fittings, a list of which concerns has already appeared in these columns, will be represented in England and Wales by a company called the Associated American Electrical Manufacturers, Limited, which has been registered under the British Limited Liability Act. The managing director of the concern will be Mr. A. F. Woodley, formerly identified in an executive capacity with the Edison-Swan Company, of London. The registered office of the company will be at 28 Bush Lane, London, E. C. The Scottish business will be taken care of by the Scottish Goudey-McLean Company, of Glasgow. Arrangements have also been made by Mr. Edward E. Goudey, the secretary of the firm, who is now in Europe, for the purpose of representing the company's interests in various parts of Continental Europe. The French business is to be taken care of by Legendre Feres, of 105 Rue de Turenne, Paris. The Dutch territory will be covered by Kopmann & Co., of Amsterdam, while arrangements have been consummated with Hubert Durselen, of Brussels, who will attend to the representation of the company's business throughout Belgium. Mr. Goudey, who will remain on the other side till May, also proposes to appoint agents in Germany, Copenhagen, Italy, Austria, Spain and Portugal.

CANADIAN BELL TELEPHONE COMPANY.—At the annual meeting of the Bell Telephone Company, held last week in Montreal, Que., the report of the directors showed that 4498 new subscribers were added during the past year, the total number of sets of instruments, now earning rental, being 42,858. The company now owns and operates 343 exchanges and 514 agencies. Over 2800 miles of wire were added to the long-distance system in 1901. Of these 1303 miles are in Ontario department, and 1540 in the Eastern department. The long-distance lines now owned and operated by the company comprises 24,193 miles of wire on 6634 miles of poles. During the year there were sold $550,000 worth of of 5 per cent bonds, the net premium on which, amounting to $53,361, has been carried to contingent account; the total bond issue now being $1,750,000. From the balance of revenue account, viz., $91,821, the sum of $50,000 has been written off plant and patent account; $10,000 has been carried to insurance reserve account, and $10,000 to accident reserve account; leaving a balance of revenue to be carried to 1902 of $21,821. The revenue account shows: Receipts, $1,851,535; expenses of operating, $1,324,424, and with other expenses, making a total of $1,433,799, which left the net revenue $417,735. From this, $400,000 dividends were paid to Jan. 15, 1902, and the balance was $17,735, which added to the balance of $74,085, totalled $91,821. This was disposed of as above mentioned.

ELECTRIC GRAIN ELEVATORS IN GALVESTON.—The Southern Pacific Terminal Company has closed contracts for a complete electric power plant, which will be used to operate its large grain elevator, now in course of construction in Galveston, Texas. The contracts for the 2000-hp boiler and engine plant were awarded to Charles C. Moore & Co., of San Francisco, who represent the Babcock & Wilcox Boiler Company on the Pacific Coast. The generating equipment includes three 300-kw units, each consisting of a General Electric 25-cycle alternating-generator direct connected to a Buckeye cross compound engine. Also, one 175-kw General Electric generator direct connected to a McIntosh & Seymour tandem compound engine. The plant will supply current for the electric motors that will operate the electric conveyers of the elevator. There will be six Babcock & Wilcox water-tube boilers and a self-supporting steel smokestack. A fuel oil system will be operated, using Beaumont oil. Among the steam apparatus may be mentioned Wheeler surface condensers, for the three large engines, and a smaller one for the small engine, vertical suction valveless air pumps, centrifugal circulating pump and the usual auxiliary machinery. John S. Metcalfe, of Chicago, is the architect of the buildings, and the plant should be in operation by Sept. 1.

VARIOUS ORDERS FOR HARRISBURG ENGINES.—The Harrisburg Foundry & Machine Company, New York office, the Mail and Express Building, has lately secured an order for a 120-hp standard engine, to be direct connected to a 75-kw Sprague generator for installation in the stone cutting plant of B. N. & G. N. Williams, for general power purposes. The Woman's Hotel at Thirtieth Street and Fifth Avenue, is to be equipped with three 90-hp Harrisburg standard engines, direct connected to 60-kw General Electric generators, to be used for lighting the building. Two 45-hp standard engines to be direct connected with 30-kw generators supplied by the General Electric Company are to be furnished the new building now under construction at Albany and Greenwich streets. This is to be a lighting outfit. The Otis Elevator Company, for its Yonkers plant, has requisitioned for a 75-hp standard engine. The generator will be supplied by the Sprague Electric Company. One 150-hp and a 100-hp Harrisburg standard engine has been ordered for general light and power purposes by the Poidebaid Silk Manufacturing Company, of Hoboken. These engines will be direct connected to generators built by the Thresher Electric Company.

VINCENNES (IND.) ELECTRIC LIGHT PLANT.—In a recent issue a note in our "News of the Week" department stated that the local electric light plant "of Vincennes, Ind.," is being sued on a mortgage foreclosure lien for $23,000. The Vincennes Electric Light & Power Company, which has been doing business since 1885, writes us that there are two electric lighting companies in Vincennes, that it is not the one in difficulty, and ask that we make the necessary correction. We regret very much that the vague character of the notice has caused annoyance to the old and substantial Vincennes company, which Mr. H. W. Frund for many years has directed with such marked success.

BALL ENGINE CONTRACTS.—The Ball Engine Company, Erie, Pa., is building for the new station of the Pennsylvania Railroad at Camden, N. J., three 250-hp cross-compound engines, each arranged for direct connection to a Westinghouse alternator. These units will run in parallel, and the engines will be fitted with speed controlling devices. The First National Bank Building, Uniontown, Pa., will have a power plant consisting of four 175-hp tandem compound engines, built by the Ball Engine Company, each of which will be direct connected to a Crocker-Wheeler generator. It will be one of the most complete isolated plants in that section.

LIGHTING PLANT WANTED FOR COREAN MINES.—The Oriental Consolidated Mining Company, which has been incorporated under the laws of West Virginia, with a capital of $5,000,000, and in which Henry C. Perkins, William L. Bull, J. B. Haggin, Ogden Mills, L. S. J. Hunt, J. S. Fassett and William P. Palmer, are interested, is about to let contracts for the electrical equipment of its extensive mines located about 100 miles north of Chemulpo, Corea. The New York address of the company is 38 Broad Street.

ELECTRICAL EQUIPMENT FOR MEXICAN PLANT.—The Compania Minera de Penoles of Mapimi, Mexico, a Belgian concern owning extensive copper properties, is about to extend its plants. Manning, Maxwell & Moore, of 85-89 Liberty Street, New York City, have been allotted an order for an electric traveling crane of 50-ton capacity to be installed on the new power station of the company. The crane, which will be operated by a 105-hp motor, is to be built by the Shaw Electric Crane Company.

INVESTING IN COPPER.—A dispatch from Phœnix, Ariz., of March 4, says: The General Electric Company, of New York, is making some of the largest purchases of copper properties ever known in the Southwest. It is stated that the company intends to spend no less than $15,000,000 in securing copper producers in Arizona and Northern Mexico.

AUTOMATIC TELEPHONE SYSTEMS.—The Clark Automatic Telephone Switchboard Company, of Providence, R. I., has recently supplied the Tolerton & Stetson Company, of Sioux City, Iowa, with an 18-point Clark automatic telephone system complete. It has also sold to the Smith Webbing Company, of Pawtucket, R. I., a 12-point equipment.

STEPHENSON CARS FOR PORTO RICO.—The John Stephenson Car Company, of Elizabeth, N. J., is about to make shipment to Porto Rico of two passenger cars and one freight, intended for the San Juan Light & Traction Company. The contract for the construction of the system was secured by J. G. White & Co., 29 Broadway.

INCREASE IN TELEPHONES.—The American Telephone Company (the Bell) reports an increase during February in the number of instruments under rental of 58,729, making total outstanding 2,637,355. This is an increase of 597,091 over a year ago, and more than double three years ago.

DANVILLE (VA.) POWER.—The Dan River Power & Manufacturing Company, R. A. Schoolfield, treasurer, is preparing to develop a water power near Danville at a total cost of $2,000,000, and will soon be in the market for bids on the equipment.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, has opened a New York office at 39 Cortlandt Street. The office will be in charge of Mr. J. P. Burckhardt, who was formerly in charge of the Cincinnati office of the Triumph Company.

WESTINGHOUSE CONTROLLERS FOR ENGLAND.—The Westinghouse Electric & Manufacturing Company is about to make shipment from its Cleveland (Ohio) plant to Manchester, England, of 150 motors, controllers, etc.

NIAGARA CURRENT.—The Oldbury Chemical Company, of Niagara Falls, contemplates building a new factory on the lands of the Niagara Falls Power Company, to utilize current from the power plant.

General News.

THE TELEPHONE.

POMONA, CALIF.—A mutual telephone company is to be formed at this place. D. S. Parker and John Law, of Pomona, are interested.

MEDORA. ILL.—Citizens have organized a local telephone exchange.

MORO, ILL.—Farmers of Foster and Woodriver townships have decided to establish a telephone line.

SHIRLAND, ILL.—The farmers of this place are discussing the question of building a rural telephone system.

LEWISTON, ILL.—The farmers of Mount Chapel are talking of building a telephone line from Duncan Mills to Havana.

FARMER CITY, ILL.—Farmers in the vicinity of Gibson are agitating for a telephone system to connect with the city service.

CHICAGO, ILL.—The Metamora Telephone Company, of Metamora, Ill., has been incorporated by J. R. Wagner, L. B. Meister and S. M. Snyder, with a capital of $280.

ALTON, ILL.—Residents of Fosterburg and vicinity have decided to establish a telephone line to Alton. The Central Union Telephone Company will build the line.

NEW BELLSVILLE, IND.—A telephone line connecting this place with Gnawbone is to be built in the near future.

VEVAY, IND.—The telephone system, owned by Green Bros., of Rising Sun, Ind., is now being incorporated. It covers all of Ohio and Switzerland counties and a part of Jefferson County.

ROANOKE, IND.—The Roanoke Telephone Company, capital stock $2,500, intends to operate a telephone system in the town of Roanoke. The directors are Ervin E. Richards, Edmond M. Wasmuth, Blanche Wasmuth and Ida M. Richards.

LAFAYETTE, IND.—Thirty-three delegates representing the People's Co-operative Telephone Association, operating eighteen independent companies, have met in conference with M. J. Carney, general manager of the Bell telephone system, for the purpose of securing an entrance into Lafayette over the Bell line.

WEVER, IA.—The Rural Telephone Company has been incorporated at this place.

ELDORADO, IA.—A business men's mutual telephone company is being formed at this place.

ODEBOLT, IA.—The Sac County Mutual Telephone Company, capital $5,000, has been incorporated by John W. Younie and others.

AVOCA, IA.—The Harlan & Avoca Telephone Company will build a toll line from Avoca to Neola as soon as the weather will permit.

NEVINVILLE, IA.—A movement is on foot at Nevinville to organize a mutual telephone company. R. H. Gregory is one of the promoters.

GLENDON, IA.—A telephone line is in contemplation from Glendon, and a meeting will be held for the purpose of organizing a company.

WINFIELD, IA.—The local telephone company will build two lines southwest toward Mt. Pleasant. Another line will be built to Mt. Union.

ALBURNETTE, IA.—The Marion & Alburnette Mutual Telephone Company will build a line in the spring with a central in Alburnette.

PLEASANT VALLEY, IA.—The Pleasant Valley Telephone Company has been incorporated; capital stock, $10,000. J. S. Wilson is one of the incorporators.

JEWELL, IA.—The Jewell Telephone Company, $15,000, has been incorporated. F. G. Snyder is president, Byron Lewis, vice-president; A. Alexander, secretary, and Giler Knudson treasurer.

GRIMES, IA.—The Farm Mutual Telephone Company, capital stock $30,000, has been incorporated by B. S. Prunty and nine others. The purpose is to construct a mutual telephone exchange in Grimes and vicinity.

DES MOINES, IA.—The local exchange of the Indianola Mutual Telephone Company has been bought by the Hawkeye Telephone Company, of Perry, which will make improvements in it and in other parts of the system at a cost of about $30,000.

GLEN ELDER, KAN.—The Citizens' Telephone Company, capital stock $2,500, has been incorporated.

ABILENE, KAN.—The addition of new rural delivery routes in Central Kansas has made a demond for more farm telephones. There are now forty farms in the county that are connected with the county seat and other towns of the county.

GRAND RAPIDS, MICH.—The Union Telephone Company will put in an exchange at Clare.

LITTLE FALLS, MINN.—John Stroman, of Swanvilletown, will build a telephone line from Swanville to Little Falls this year.

MONTICELLO, MO.—The Lewis County Telephone County has increased its capital stock from $1,800 to $7,500.

JEFFERSON CITY, MO.—The Missouri & Kansas Telephone Company has increased its capital from $2,500,000 to $5,000,000.

ADRIAN, MO.—The Board of Aldermen has granted a fifteen-year franchise to the Austin Inland Telephone Company for a telephone system here.

AUSTIN, MO.—The Austin Inland Telephone Company, capital $2,000, has been incorporated by G. S. App, C. E. Schooley, C. Z. Wiley and others.

ST. LOUIS, MO.—The National Subway Company of Missouri at St. Louis filed a statement last week of increase of capital stock from $250,000 to $2,000,000.

HOLDEN, MO.—The Farmers' Independent Telephone Company, which was recently incorporated, now has sixty party line subscribers and thirty-five miles of toll line. Its rates are $15 a year. The company is using Swedish-American telephone apparatus, and is an auxiliary to the Holden Telephone Company, which operates a National automatic board. The Farmers' Company is contemplating building twenty-five miles of full metallic toll lines, and twenty-five miles of party line grounded circuits.

JOPLIN, MO.—The telephone system of Joplin, Carthage, Webb City and Oronogo, Mo., have been merged into one company, known as the Mineral Cities Telephone Company, and has incorporated under the laws of Missouri, with a paid-up capital of $300,000. Headquarters are to be established in Joplin, and $50,000 is to be expended in improving the system. J. W. Layrie, of Carthage, is president of the new company. E. J. Layrie and J. L. Moore, of Carthage, and Geo. W. Layrie, of Joplin, are members of the company. Chicago and St. Louis capitalists are also interested.

WAHOO, NEB.—The Golden Rod Telephone Company, of Wahoo, capital stock $50,000, has been incorporated by W. H. Hurst, M. M. White and T. E. Parmele.

YORK, NEB.—There is to be a meeting of the county independent telephone companies in this city for the purpose of determining whether to establish a central station.

LINCOLN, NEB.—The Milburn & Anselmo Telephone Company filed articles of incorporation with a capital stock of $10,000. The company is to build a line between the towns of Milburn and Anselmo in Custer County. Calvin A. Snyder and W. E. Sengel are the incorporators.

VALLEY, NEB.—At a meeting of representative citizens it was decided to incorporate a stock company with a capital of $10,000 for the purpose of establishing an independent telephone system. The idea is to build in each direction from town and eventually connect with other independent companies throughout the State.

NEW YORK, N. Y.—Fire Commissioner Sturgis is giving trouble to the Manhattan Fire Alarm Company, which for several years past has been giving a valuable auxiliary service, and now has in New York 900 plants with 2400 fire alarm stations in hotels, theatres, factories, apartment houses, etc.

NEW YORK, N. Y.—Borough President Louis F. Haffen, of the Bronx, has begun a crusade against the telegraph and telephone poles on the principal thoroughfares of the Bronx. In these streets where subways have already been built Mr. Haffen will order the removal of all overhead wires. Urged on by numerous complaints, Mr. Haffen sent a letter to the Board of Estimate and Apportionment calling for its assistance in the matter.

BROCTON, N. Y.—The Portland Telephone Company has recently added fifty subscribers to its service, the total number now being 130. Its rates are $12 a year for residence telephones and $15 for office and business instruments. It uses apparatus of the Eureka Electric Company, Chicago, and is preparing to extend its lines about ten miles. It is also looking for an increase in the number of subscribers in the immediate future.

MINOT, N. D.—The Minot Light & Telephone Company has been incorporated by J. J. Barclay, F. C. Clark and L. M. Davis.

FARGO, N. D.—The announcement is made that the Northwestern Telephone Company will erect a new exchange building this spring.

MANDAN, N. D.—The Mandan Telephone Company has been incorporated by C. E. F. Draper, Hattie Draper, P. Tobin and T. R. Brewer.

NEPTUNE, OHIO.—A telephone exchange will be built at this place in the near future.

CONVERSE, OHIO.—The Jennings Telephone Company, with a capital of $10,000, has been incorporated.

DEFIANCE, OHIO.—The Central Union Telephone Company is equipping a new exchange building in Defiance.

MARYSVILLE, OHIO.—W. E. Liggett, of the local telephone exchange, is putting in a farmers' exchange at York, with 60 subscribers.

APPLE CREEK, OHIO.—The East Union Telephone Company has been incorporated by S. K. Garver, H. H. Murnam, J. P. Ryan, F. S. Kinstutz, G. W. Hackett and R. A. Pfouts.

CIRCLEVILLE, OHIO.—The Circleville Citizens' Telephone Company has increased its capital stock from $30,000 to $68,000. E. E. Smith is president and C. C. Chappelear, secretary.

BELLEFONTAINE, OHIO.—The Ada Telephone Exchange, including about 100 miles of toll line, has been purchased by C. E. Yoder, of Bellefontaine, and A. A. Geiger, of Bluffton, Ohio.

BELLEFONTAINE, OHIO.—The United Telephone Company, with a capital stock of $250,000 has been incorporated my G. M. Stimpson, Wm. Harris, Edward H. Fledderjohann, L. W. Fawcett, B. F. Coppers and C. E. Yoder.

OKLAHOMA CITY, OKLA.—Local capitalists are getting plans ready for the construction of a new long distance telephone line from here to Andarko.

CLEVELAND, OKLA.—The Cleveland Telephone Company, capital $10,000, has been incorporated by O. A. Gilbert, G. G. Means and G. W. Sutton, of Cleveland.

NORRISTOWN, PA.—The Montgomery Telephone Company, capital stock $5,000, has been incorporated. Directors: John H. Schultz, E. M. Michener, J. W. Brunner, A. H. Schults, D. M. Anders, B. W. Dambly and A. K. Dresher.

TYNDALL, S. D.—The Farmers' Telephone Company, capital stock $5,000, has been incorporated by Thos. A. Billy, E. A. Boska, Joseph V. Way and F. F. Chloder.

SIOUX FALLS, S. D.—Farmers living between the towns of Alexandria and Farmer are arranging for the construction of a telephone line between these points.

ALEXANDRIA, S. D.—The Edgerton Telephone Company, capital $8,000, has been incorporated by W. A. Caldwell, Frank L. Bond, M. Pitts, L. A. Piper and E. H. Card.

BEAUMONT, TEX.—The Beaumont Telephone Company has increased its capital stock from $60,000 to $120,000.

GREENVILLE, TEX.—The Greenville Telephone Company has been incorporated by J. T. Young, C. H. Jones and L. A. Clarke; capital stock, $25,000.

HILLSBORO, TEX.—W. D. Okell and others have petitioned the City Council for a fifty-year franchise for the purpose of establishing an independent telephone exchange.

DENISON, TEX.—J. N. Hughes, president of the Chickasaw-Choctaw telephone line, states that the company's line will be extended at once from Durant eastward to connect with the towns on the Arkansas and Choctaw on the east, and then be built to Wister north. The line will then be built west from Durant to Wichita Falls, Tex.

SALT LAKE CITY, UTAH.—The annual report of the Rocky Mountain Bell Telephone Company shows that during the last year fifteen new exchanges and 3,622 subscribers were added to the service. New construction included 859 miles of new toll pole lines and 3038 miles of wire. These improvements, together with others not yet completed, cost $545,406. The financial statement of the year shows a net increase in revenue of $46,608.

LEESBURG, VA.—Arrangements are being perfected for a telephone line from Hillsboro into Loudon, to Harper's Ferry in West Virginia.

SWANTON, VT.—The People's Telephone Company, of St. Albans, is talking of building a line to Swanton in the spring.

EAGLE, WIS.—The Eagle Telephone Company, capital $3,000, has been incorporated by E. J. Lins, Frank Kloppenburg and Henry M. Loible.

EAU CLAIRE, WIS.—The Wisconsin & Minnesota Telephone & Telegraph Company, capital $75,000, has been incorporated by A. S. Munsell, T. F. Frawley and H. A. Field.

JUDA, WIS.—The Jefferson Telephone Company, capital $2,500, has been incorporated by George Barnum, J. S. Ohl, J. C. Emerich, Fred. M. Carter and M. Randall and S. D. Benage.

MONROE, WIS.—Farmers living near Juda have formed a telephone company to build a line through the farming country twelve miles south. The company will be incorporated for $5,000.

EAU CLAIRE, WIS.—A new telephone corporation has taken the franchise of the Osseo Telephone Company in the city of Eau Claire, which, however, continues to operate in a large outside territory.

APPLETON, WIS.—The operators in the Fox River Valley Telephone Company's office in this city went out on a strike a few days ago, the reason for their action being stated that the office superintendent was "too friendly" with one of the young lady operators.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Mutual Electric Light Company, San Francisco, has been granted permission by the Board of Supervisors to erect a storage tank for fuel oil adjoining its electric power plant. The Mutual company will try petroleum, although one of the owners of the system is largely interested in coal mines.

SAN FRANCISCO, CALIF.—At a recent meeting of the Board of Presidents of the Salt Lake Valley Canal Companies, held in Salt Lake City, the project of establishing an electric pumping system for increasing the flow of water from the lake was considered without reaching a definite conclusion. It is estimated that the entire installation would cost about $15,000.

OAK PARK, ILL.—The electric light company's plant was seriously damaged by fire on March 3.

AYER, MASS.—Curtis & Sederquist, of Boston, have purchased the $10,000 5 per cent. twenty-year bond issue of the Ayer Electric Light Company, of Ayer, Mass., recently authorized by the railroad commissioners for extension of plant.

NILES, MICH.—The St. Joseph County Supervisors have granted a franchise to the Michigan Electrical & Hydraulic Company to build dams at Lelands, Henshaw, Becker and Colon on the St. Joseph River. It is the intention of the company to utilize the water power derived from these dams for manufacturing and street railway purposes.

HUNTSVILLE, MO.—The citizens of this city have appointed a committee to visit the neighboring towns to consult regarding an electric light plant.

ST. CHARLES, MO.—The last of St. Charles' city electric light bonds amounting to $4,500, were burned at the City Hall last week. St. Charles now owns its electric light plant, which is one of the best in the State in cities of the third class.

ST. LOUIS, MO.—The chief engineer of the water works extension advocates the building of a three-unit electric generating plant at the water works to supply power for lighting the insane asylum, female hospital, poorhouse, and several police stations and engine houses. His plan is for the city to buy a storage yard and erect shops in it.

JERSEY CITY, N. J.—On the night of March 4 an accident occurred in the electric light plant at the Pennsylvania Railroad Station in this city, which cut off all electric light in the big depot for a couple of hours after 10:30 o'clock. All the candles in the neighborhood were bought up, and passengers were ushered to the trains by candle and lantern light.

FOSTORIA, OHIO.—Barber Bros., of Delaware, Ohio, have been granted an electric light franchise and will give service as soon as possible.

ELYRIA, OHIO.—The Elyria Gas & Electric Light Company has been granted a franchise for steam heating, and will put in a plant to do such work throughout the city.

HUBBARD, OHIO.—The Council has passed a resolution setting forth the necessity of bonding the town for $8,000 for the purpose of building a lighting plant. An election will be held at once to vote on the measure.

FOSTORIA, OHIO.—The Fostoria Council has granted a franchise to the Barber Brothers of Delaware, Ohio, for a steam heating and electric lighting plant in this city. The company will build a plant at once and will enter into competition with existing lighting companies.

CLEVELAND, OHIO.—M. A. Bradley is preparing to erect another large power building. The Bradley Heat, Light & Power Company furnishes electrically transmitted power to a large group of buildings in the center of the city, nearly all of them owned by Mr. Bradley.

NEW RICHMOND, WIS.—A deal has been practically closed whereby a syndicate of Stillwater capitalists will become owners of the Apple River power plant, taking over all its property, water powers, rights franchises, etc., developed and undeveloped.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—Attorney General Tirey L. Ford, who represents the Baltimore syndicate which will purchase the Market Street Railway, has prepared the final papers of transfer and the properties will change hands on March 28. The total amount involved is $13,500,000, the largest street railway deal ever made on this coast. The transfer includes not only the Market street cable road and its branches, but the Sutter street cable road and the San Mateo electric line to the cemeteries.

SAN FRANCISCO, CALIF.—The outcome of the contest for street railway franchises in Los Angeles was the decision of the City Council to re-advertise for bids for the possession of the franchises. The Huntington-Hellman syndicate, which operates the Los Angeles Railway, was the original applicant for the franchises. It was awarded the franchises at a recent council meeting after the persons acting for Senator W. A. Clark had made the highest cash offer. The Huntington interests were allowed to raise their bid to $152,000, while the Clarks had bid $139,000. Mayor Snyder next vetoed the ordinance granting the franchises to the Huntington company, because he was opposed to permitting the hauling of freight within the city, as was provided in some of the franchises.

DENVER, COLO.—The Colorado Springs & Suburban Company has closed a contract with the North American Construction Company for the laying of new track on all its lines. Work will begin at the Manitou end of the line.

DANVILLE, ILL.—Henry Clague, Frank Caine, and Sherman W. Watterson, of Cleveland, have applied for a franchise from the county, for an electric railway to connect this city with Champaign and Urbana, traversing one of the richest agricultural sections of Illinois. They agreed to commence construction work immediately and have cars running within two years.

NEW CASTLE, IND.—The directors of the Newcastle & Pendleton electric railway have asked a subsidy of $27,500 from Henry Township and $16,500 from Harrison Township of Henry County. The first named township is not likely to vote the subsidy, as it is understood that the Union Traction Company is willing to build a line through the township without aid. In Harrison Township conditions are different and the subsidy will go through.

SHELBYVILLE, IND.—The Indianapolis & Shelbyville Traction Company, which is constructing a line between this city and Indianapolis, has filed a mortgage for $500,000 to cover a bond issue for construction purposes. The officers of the company say they will spend over $600,000 in the completion of the road. The company has also accepted a franchise from the city for one of the principal streets and a loop. The company expects ultimately to build on to Cincinnati.

WABASH, IND.—General Manager Law, of the Wabash River Traction Company, operating the interurban line between this city and Peru, announces the sale of the entire issue of $300,000 of 5 per cent bonds authorized by the company, at a fraction over 95, yielding $275,000. The proceeds are to be used in the construction of the Peru line or to build a new one to Marion. The company is also seeking the right of way through the counties of Miami and Cass to Logansport, and will soon have an extensive system.

TERRE HAUTE, IND.—No progress has been made toward a settlement of the strike and boycott of the Terre Haute Street Railway Company. Manager Clark has repeated his declaration that he will confer only with old employes and in no case will the matter of unionism be considered. The miners who have been holding a convention at Terre Haute voted $1,000 in aid of the strikers and refused to ride on the company's cars. This action has stimulated the strikers and renewed the boycott. Merchants are complaining of a loss of business, the boycott having lasted over six weeks.

INDIANAPOLIS, IND.—New York attorneys have filed four suits in the Federal Court for the Sprague Electric Railway & Motor Company of New York, and the Thomson-Houston Electric Company of Connecticut against the Indianapolis & Greenwood Rapid Transit Company and the Indianapolis and Greenfield Electric Railway Company. The Sprague company charges that the interurban lines are using certain improvements on motors and are infringing on the Sprague company's patents. The Thomson-Houston company makes the same charge in regard to the "contacts" and switches, and that the concerns that supplied them had no right to sell them. Both plaintiffs ask for permanent injunctions and an accounting of the profits derived from their use.

DETROIT, MICH.—The Grand Rapids, Holland & Lake Michigan Railway Company has increased its capital stock from $500,000 to $1,000,000. The extra stock has been taken by the present stockholders and the money will be used for improvements on the road.

CLEVELAND, OHIO.—Stockholders of the Cleveland, Elyria & Western Railway Company have ratified the recent purchase of the Elyria, Grafton & Southern Railway.

XENIA, OHIO.—The Greene County Commissioners have granted a franchise through the county to the Xenia, Cedarville, Jamestown & Wilmington Traction Company.

CANTON, OHIO.—The Stark Electric Railway Company, which is building a line from Canton to Alliance, has commenced proceedings to condemn a private right of way into the city.

COLUMBUS, OHIO.—The new power house for the Columbus, London & Springfield Railway, located between Vienna and Sumerford, was badly damaged by a wind storm recently. It was almost completed and ready for the roof.

WARREN, OHIO.—The promoters of the Conneaut & Southern Electric Railway Company have asked for a franchise through Trumbull County for the line which is to extend from Conneaut to Youngstown. Much of the road will be on private right of way.

FINDLAY, OHIO.—The various electric railway interests centering in this city are contemplating the feasibility of constructing a belt line around the city. Two lines are in operation, two more are partially completed and two others are being strongly projected.

PIQUA, OHIO.—The Western Ohio Railway Company is endeavoring to make a traffic arrangement whereby its cars may enter the center of Piqua over the tracks of the Miami Valley Traction Company, making it unnecessary to build a second line into the town.

CLEVELAND, OHIO.—In connection with the sale of the controlling interest in the Cleveland Electric Railway Company, the resignations of Henry A. Everett, Fred. E. Borton and Charles W. Wason as president, secretary and purchasing agent, respectively, have been handed in.

LOUDONSVILLE, OHIO.—Preliminary surveys are being made on the Wooster & Mansfield Railway. The road will pass through Loudonsville and Perrysburg, and it is stated that the power-house will be established at Loudonsville. The section of the road from Loudonsville to Wooster will be built first.

SANDUSKY, OHIO.—The promoters of the Sandusky, Bellevue, Monroeville & Norwalk Railway and the Sandusky, Clyde, Tiffin & Southern Railway are considering a plan for entrance to the city by means of a long overhead bridge over the Lake Shore tracks and other low points. The Lake Shore objects to another grade crossing.

COLUMBUS, OHIO.—The Mansfield, Greenwich & Norwalk Electric Railway Company, capitalized at $10,000, has been incorporated by S. S. Ford, Cleveland; W. W. Stark and J. C. Laster, of Richland County, and C. P. Wickham, R. H. Reynolds, J. Cleland and M. J. Roseboro, of Huron County. Officers have been elected as follows: S. S. Ford, president; C. P. Wickham, vice-president; Dr. R. H. Reynolds, second vice-president; W. W. Stark, treasurer; M. J. Roseboro, secretary, and J. Cleland, general manager. The company has secured private right of way for a line from Mansfield to Norwalk.

CINCINNATI, OHIO.—The Suburban Traction Company has given a trust deed for $600,000 to the Cincinnati Trust Company to secure 200 bonds for $1,000 each and 800 for $500 each, all payable Jan. 1, 1927, with interest at 5 per cent. The mortgage covers all property of the line now being built from Cincinnati to Bethel, Clermont County. G. K. Scrugham is president and Lee H. Brooks, secretary of the company.

DAYTON, OHIO.—The Dayton & Troy Traction Company and the Dayton & Western Traction Company have entered into an arrangement with the Southern Ohio Express Company whereby the latter will collect and deliver freight and express matter for these roads. The plan will be of great advantage to shippers and will obviate the difficulties caused by the city's ruling that cars must not be unloaded inside of a large district in the center of the city.

CLEVELAND, OHIO.—In providing additional equipment to take care of extensions under construction, the Cleveland, Elyria & Western Railway of Cleveland, has decided to install steam turbines for driving the new generators. Contracts have recently been closed for two 1000-kw Parson turbines running at 1500 r. p. m. to be direct connected to two 1000-kw, two-pole Westinghouse turbine generators. Also for two 30-kw exciters, to be direct connected to the shafts of the generators.

COLUMBUS, OHIO.—The Mansfield, Mt. Gilead & Delaware Electric Railway Company has been incorporated, with $10,000 capital stock, by C. E. Ertzinger, C. W. Fritz and W. J. Burkett, of Mansfield; W. P. Wiseley and F. L. Fenstemacher of Findlay, and C. D. Smiley, of Mt. Gilead. The line will be fifty miles in length and will form a connecting link between lines leading out of Columbus and Cleveland. The promoters claim the money to finance the road will be forthcoming as soon as twenty miles of right of way is secured.

CINCINNATI, OHIO.—Messrs. Sheets and Beard, of Brookville, Ind., and Martin Barnes, of Groesbeck, Ohio, are promoting an electric railway to extend from Brookville, Ind., through Scipio, Okeana, Shandon, Ross, New Baltimore, Barnesburg and Groesbeck to Fairmount on the outskirts of this city. Several roads have been projected over this route with no practical results, and now these parties, who are large property owners, will push the project. Land owners will be asked to subscribe $100,000 worth of stock in the company.

TOLEDO, OHIO.—The Toledo & Indiana Railway Company held its annual meeting recently. New officers were elected as follows: C. P. Griffin, president; George G. Metzger, vice-president; C. H. Masters, secretary; A. K. Detwiler, treasurer. Directors: C. P. Griffin, George G. Metzger, A. K. Detwiler, Frank Yesbera, C. H. Masters, Dudley Watson, Dr. James Donnelly, F. S. Ham, L. E. Flory, L. W. Brown and J. R. B. Ransom. Construction work will be resumed as soon as the weather will permit. Ten miles between Delta and Holland has been graded. It is the intention to have cars running between Toledo and Wauseon by Oct. 15.

PORTLAND, ORE.—The Oregon Short Line Railroad will begin the construction of an electric railway from Shoshone to Shoshone Falls, which later will be extended into Nevada.

PHILADELPHIA, PA.—The coalition of the Union Traction Company and the New Street Railway Company, organized under an act of the last State Legislature, was finally agreed upon at a meeting of the Board of Directors of the former corporation March 3. The question will be voted upon at a special meeting of the stockholders of the Union Traction Company on May 5, and there is no doubt of the ratification of the project.

WHEELING, W. VA.—A meeting of the directors of the Wheeling Traction Company was held a few days ago and it was decided to push the work on the line of the Steubenville extension so that it may be completed this summer. Contracts have been closed for the equipment of the new power station.

BARABOO, WIS.—For several years a movement has been on foot for the building of an electric railway between the Dells of the Wisconsin and Devil's Lake. Last fall a company was formed by a party of Chicago capitalists, including G. I. Hicks, E. W. Farnham and others, under the name of the Sauk County Traction & Power Company. This city has granted it a franchise. The power for the generating stations will probably be secured from the new dam across the Wisconsin River at Kilbourn. Beside a passenger traffic the company expects to do a freight business, connecting with the Milwaukee road at Kilbourn.

LEGAL.

TELEPHONE SWITCHBOARD CASE.—The decision of the lower court, in the case of the Western Electric Company against the Kinloch Telephone Company, was affirmed Feb. 18 by the Federal Court of Appeals at St. Louis. The Western Electric Company sued the telephone company for infringement of patents granted to John A. Seely in November, 1885, for an improvement in grouping spring jacks and annunciators for multiple switchboards. The telephone company alleges that the devices complained of were not those covered by the letters patent, but were the production of mechanical skill, and not the result of inventive faculty. The United States Circuit Court rendered a judgment in favor of the Western Electric Company to the effect that the Kinloch Telephone Company had infringed on the patent, and it enjoined the latter from using the invention. The Kinloch Telephone Company appealed the case, giving bond. The case was reviewed by the Federal Court of Appeals, which has upheld the judgment of the lower court. The Kinloch Company will ask for a rehearing, and in case this is denied, a new device would be introduced, it is said, by the manufacturers of the switchboards, without interference in the slightest degree with the service. The telephone company claims that the subject of the litigation was a minor device and not in anywise one calculated to interfere with service by its removal.

PERSONAL.

MR. CHARLES E. DUSTIN, president of the Charles E. Dustin Company, of No. 11 Broadway, New York, has returned from a six weeks' trip to Cuba.

MR. FREDERIC NICHOLLS, the well known general manager, etc., of the Canadian General Electric Company, has been in New York this week at the Waldorf, on a trip from Toronto.

MR. THOMAS F. RYAN has gone to California for a trip of some weeks' duration. His special car was caught in a serious railway disaster last week in Texas, but the party escaped from sustaining any noteworthy injury.

MR. W. T. WALLACE, the secretary of the United Telpherage Company, starts this week for England and the Continent, where this excellent system of aerial freight transportation is beginning to attract considerable attention.

MR. ROBERT W. BLACKWELL, after a visit of some weeks to this country, is sailing on March 15 for England, where the business of Robert W. Blackwell & Company has assumed very large proportions, with branches on the Continent.

GENERAL T. T. ECKERT has resigned as president of the Western Union Telegraph Company, but will remain in office as chairman of the board of directors. He is succeeded by Col. Clowry, now vice-president and general superintendent.

MR. JOHN S. BOYD, long time secretary and treasurer of the Southern Electric Company of Baltimore, Md., notifies us that he has now established himself as an electrical engineer and manufacturers' sales agent at No. 12 North Charles Street, that city.

MR. R. L. MACDUFFIE, of Wendell & MacDuffie, whose offices are in the Havemeyer Building, 26 Cortlandt Street, New York, has sailed for Cuba, with a view to closing some important contracts in connection with electric traction equipments in that part of the world.

MR. W. B. RANKINE, of the Niagara Falls Power Company, had the honor last week of receiving Prince Henry of Prussia at the big power-house at the Falls, and explaining its features of interest. Prince Henry was greatly pleased with what he heard and saw there.

MR. HENRY FLOY, the consulting electrical engineer, returned last week on the "Deutschland" from Cherbourg, having spent two months in Italy and France, with the object of ridding himself entirely from the effects of the serious attack of typhoid fever, from which he had lately convalesced. He has resumed active practice.

PROF. PASQUALINI, the chief electrician of the Royal Arsenal of St. Bartolomeo, Spezia, Italy, has resigned his connection with the Italian Government in order to become associated with the Galileo Works, of which Mr. G. Martinez is the manager, at Florence. This will give Prof. Pasqualini an excellent opportunity in the electro-technical industries.

MR. MAURICE COSTER, the present manager of the sales department of the French Westinghouse Electric Company, and well known also as the former manager of the Chicago offices of the same interests, was married on Feb. 19 to Miss Augusta Blanche Bennett, on the Isle of Jersey. A host of American friends join in congratulations and best wishes.

MR. WILLIAM D. RAY has opened an office for the practice of electrical and mechanical engineering in Detroit, at 1015 Chamber of Commerce Building. Mr. Ray was electrical engineer of the Detroit Construction Company in the building of the Detroit, Lake Orion & Flint Railway and the Grand Rapids, Holland & Lake Michigan Rapid Railway, and was for a number of years manager of the Everett, Wash., Railway & Electric Company.

MR. G. MARCONI has left New York for Canada to supervise the arrangements for a permanent signal station on Cape Breton. The inventor will confer with officials of the Canadian government to obtain final assurances of their co-operation and that the recent action of the English Postmaster General will

not affect his rights to use the system on Canadian soil. Mr. Marconi will not remain in the Dominion more than a fortnight, thence returning to New York on his way to England. As soon as the apparatus is installed at Cape Breton he will come back from abroad to conduct experiments.

Trade Notes.

MR. E. P. THOMPSON, the patent lawyer, 156 Fifth Avenue, New York City, has issued a batch of new literature relating to patent expert work, and giving also some testimonials from his clients, references, etc.

MESSRS. JOHNSON & MORTON, Utica, N. Y., are sending out a large private postal card containing some brief facts and illustrations of one of their standard junction boxes. The firm also announces that it has equally good things in switches.

THE TELEPHONE DEPARTMENT of the Electric Appliance Company, Chicago, has just issued circulars describing its Eaco visual signal metallic circuit switchboards and its Eaco country or party line switchboards for metallic or grounded circuits.

THERMOSTATIC FIRE ALARM.—Mr. H. C. Vierkant, Tarrytown, N. Y., is manufacturing a thermostatic fire alarm for dwellings, factories, etc., which appears to have some distinct advantages. It is adjustable to any degree of temperature, and apparently will work well and satisfactorily in practice.

DYNAMO FIELD RHEOSTATS.—The Wirt Electric Company, Philadelphia, Pa., in Circular No. 195 describes and illustrates the construction of Wirt dynamo and field rheostats. The various constituent parts are shown in illustrations, and tables give the dimensions of the different sizes of rheostats.

FORT WAYNE CALENDAR.—An artistic calendar for March has been issued by the Fort Wayne Electric Works, Fort Wayne, Ind. All of the lettering is represented in high relief with strong shadows, and makes a very effective and attractive calendar to hang up over the desk. The card contains illustrations of Fort Wayne induction wattmeters.

PANEL BOARDS.—Messrs. Zimdars & Hunt, 127 Fifth Avenue, New York, have issued two pamphlets on the subjects of panel boards and slate linings for panel board cabinets. Different styles of panel boards are illustrated in pamphlet No. 2, together with price lists, etc., and pamphlet No. 3 gives prices, code words and other information about slate linings.

ELECTRICAL SUPPLY CATALOGUE.—Messrs. W. R. Ostrander & Company, 22 Dey Street, New York, have just issued the thirteenth edition of their catalogue of speaking tube hardware, electric light material, telephone and telegraph instruments, electric bells and batteries, and general electrical supplies. The catalogue has 296 pages and is profusely illustrated.

BOOK TYPEWRITERS.—The Elliott & Hatch Book Typewriter Company announces that it has just placed on the market a very much improved book typewriter. It has also recently brought out four new sizes of machines. The merits of these book typewriters are described in special booklets which can be had on application at the company's office, 256 Broadway, New York.

THE STORY OF HUMAN PROGRESS.—Under this heading the Goheen Manufacturing Company, Canton, Ohio, has issued a pamphlet concerning its "carbonizing coating," which is a paint that protects iron and steel from rust and corrosion. This material has stood the test of time. Various illustrations show steel buildings, bridges, etc., on which this coating has been used.

MORE THAN A CATALOGUE.—It is a book of information on alternating current wattmeters. It treats in a most complete and comprehensive manner of the Gutmann integrating alternating current wattmeters. There is no reason why wattmeters should be a mystery—get the book—and that is easily done by dropping a card to the Electric Appliance Company, Chicago.

TELEPHONE CATALOGUE.—The Kellogg Switchboard & Supply Company, Chicago, in Bulletin No. 7 shows a few of the many styles of instruments which it is prepared to furnish. The various styles of complete instruments are clearly illustrated, the halftones used in the work being very artistically executed. The bulletin contains considerable information of interest to telephone men.

"FEMCO" LAMPS.—A handsome new catalogue descriptive of the "Femco" incandescent lamp is being mailed by the Franklin Electric Manufacturing Company, Hartford, Conn. The several types in which the "Femco" lamps are made are shown in full sized illustrations. The catalogue contains much useful information for incandescent lamp users. A copy will be mailed to any one interested on application.

VARNISH CLOTH.—The Sills-Eddy Mica Company, Broad Exchange, New York, is sending out a folder to the trade containing a sample of its Imperial varnish cloth made up by its new method. This cloth is manufactured in rolls up to 500 yards of desired so long. The varnish is put on much more evenly and the goods, it is stated, stands a much higher insulation test than under the old method. The voltage breakdown test of this varnish cloth is stated to be 3500 to 6000 volts.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., is sending out new bulletins of its apparatus, the subjects of which are: Compound starting rheostats with automatic release; non-reversible drum controllers for printing presses, machine tools, etc.; drum controllers with two reverse speeds, specially adapted for printing presses, and rope-operated reversible drum controllers for cranes, hoists, etc. These various pieces of apparatus are illustrated and price lists of the different sizes given.

CLARK TELEPHONE SWITCHBOARDS.—The Clark Automatic Telephone Switchboard Company, 15 Custom House Street, Providence, R. I., has just issued a 16-page pamphlet containing copies of many testimonial letters received by it from all over the country, and one from France. All the writers of these leteers speak in praiseworthy terms about the apparatus of this company. A list at the back of the pamphlet shows that the Clark automatic system is used in England, South France, Amsterdam, Holland, Honolulu, etc.

THE LIBERTY ELECTRICAL SUPPLY COMPANY is the name of a new concern recently started at 136 Liberty Street, New York, to handle a full line of electrical supplies and act as manufacturers' agent for provincial houses. The new company is being managed by Mr. B. Rosenberg, for ten years with the Manhattan Electrical Supply Company, of New York, and Mr. J. H. Newman, well and favorably known in business circles. The company is starting out with a complete line of supplies, and states that it is prepared to fill all orders promptly.

MR. F. C. HARDON, secretary of the Carstarphen Electric Company, of Denver, Col., has recently been in the East on a business trip. The Carstaphen Electric Company is building the large induction coils and other apparatus to be used by the Pacific Wireless Telegraph Company at their stations at Los Angeles and Santa Catalina Island. Such instruments have not hitherto been manufactured in that region, and it is gratifying to note that Colorado now has an establishment that can produce the most delicate electrical and other scientific apparatus.

POLES, TIES, ETC.—The Maltby Lumber Company, Bay City, Mich., is sending out to its trade a folder giving a lot of interesting information regarding its poles and cross ties for steam and trolley roads. The company's principal yards for sorting poles are located at Boyne Falls and Pinconning, and it employs competent and trained inspectors at each yard to see personally to the count and grade of stock of every car shipped. Every one concerned in poles and cross ties will find much information of interest in this folder, a copy of which can be had on application to the company at Bay City.

THE STILWELL-BIERCE & SMITH-VAILE COMPANY, Dayton, Ohio, announces that it has recently made a change in the management of its Philadelphia office. Mr. P. B. Fenlon is no longer connected with the company as manager of that office, having been succeeded by Mr. O. G. Smith, who has been in charge of the company's air compressor department. Mr. A. L. McClurg, who has been connected with the Harrison Safety Boiler Works for the past six years, has also entered the employ of the Stilwell-Bierce Company, and will make his headquarters in Pittsburg in connection with Mr. E. F. Austin, the company's sales agent.

A NEW TYPE OF PUSH SWITCH has just been put on the market by the Hart & Hegeman Manufacturing Company, Hartford, Conn. This new switch differs considerably in pattern from any heretofore produced, and it is claimed for it that it is the most easily operated switch made. One of the features of the new pattern is a much longer break than is obtained in other switches of the kind. With this push switch, the manufacturers are supplying a face plate 1¾ inches wide by 4½ inches long—considerably larger than that furnished with any other push switch. This feature will prove particularly useful to contractors in installing the switch in old work.

DOWN-DRAFT FORGES.—The Buffalo Forge Company, Buffalo, N. Y., is calling attention to an interesting testimonial from the "Big Four Route" Railroad Company in reference to the Buffalo Company's down-draft forges, purchased and placed in service in 1895 in the railway company's blacksmith shop at Wabash. They have ever since been giving satisfactory performance. Mr. Garstang, superintendent of motive power, considers that the down-draft system is excellent, principally on account of the removing of the smoke from the shop and in not requiring overhead pipe or other obstructions to interfere with or prevent the handling of heavy work with cranes.

SMALL MOTORS AND GENERATORS.—The Northern Electrical Manufacturing Company of Madison, Wis., has issued a bulletin describing the Watson type of small motors and generators, which it has recently placed on the market. These little machines are a radical departure in design and construction from other small motors or generators being constructed with multi-polar fields. The armatures are also built on the same plan as followed in the construction of larger machines. They have slotted laminated cores laid with form wound coils and arranged for perfect ventilation. The illustrations show the machines to be neat, compact and symmetrical. At present the machines are built in sizes from ⅛ to 2 horse-power.

WISCONSIN GRAPHITE PRODUCTS.—Wisconsin graphite paint comes in six different shades, has a bright lustre, a very even surface, and long life. It practically incorporates itself into the iron and steel wherever applied. The Wisconsin Graphite Company, Pittsburg, has a most excellent graphite preparation, known as the Wisconsin graphite stack paint, which will wear for years and is being largely used by manufacturers and mill owners generally throughout the country. This company manufactures the well known Wisconsin flake graphite lubricant, which not only obviates all friction, but is positively without grit and is absolutely smooth. It is especially adapted for powerful engines, dynamos and machinery, and the best results have justified the company's advocacy of it. Free samples will be sent to any one upon request.

POLYGLOT CATALOGUE.—A novelty in the catalogue line has just been brought out by the Cutter Electrical & Manufacturing Company, Philadelphia, Pa. It is called the "I. T. E. Circuit-Breaker Polyglot Catalogue," and is stated by the Cutter company to be the most complete circuit-breaker catalogue ever published. It is printed in English, French, German and Spanish, and its translation into the foreign languages occupied more than a year's time. It contains very complete information on its subject in all four languages. The dimensions of the apparatus are given in inches and centimetres, and the weights in pounds and kilogrammes. This catalogue is very interesting and will no doubt serve a very useful purpose. The translation of its contents into these foreign languages will place in the possession of electricians in the different countries in which these languages are spoken information that would be difficult to obtain through the ordinary channels. The catalogue is of large size, and necessarily so since the text has been expanded into four languages. The front cover contains a view of an I. T. E. circuit-breaker printed in bronze colors to correspond with those of the metallic parts of the instrument.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED MARCH 4, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

693,918. PROCESS OF FORMING BODIES BY ELECTRODEPOSITION; C. Steinweg, Ludenscheid, Germany. App. filed July 1, 1901. (See Current News and Notes.)

694,349. PROCESS OF RECOVERING GOLD FROM REFRACTORY ORES; H. R. Cassel, New York, N. Y. App. filed June 12, 1901. (See Current News and Notes.)

694,350. APPARATUS FOR RECOVERING PRECIOUS METALS FROM REFRACTORY ORES; H. R. Cassel, New York, N. Y. App. filed June 12, 1901. (See Current News and Notes.)

694,410. ELECTRIC ARC LAMP; M. S. Okun, New York, N. Y. App. filed Sept. 16, 1896. An arc enclosing globe having an opening for the carbon pencil and mounted to move laterally to accommodate irregularities in the pencil.

694,425. ELECTRIC RAILWAY SYSTEM; J. Ryan, Watertown, N. Y. App. filed Oct. 8, 1900. The switchbox contains a solenoid whose core carries a cup of mercury which is lifted when the solenoid is energized to carry the mercury into contact with two terminals. When the circuit is broken the cup lowers by gravity.

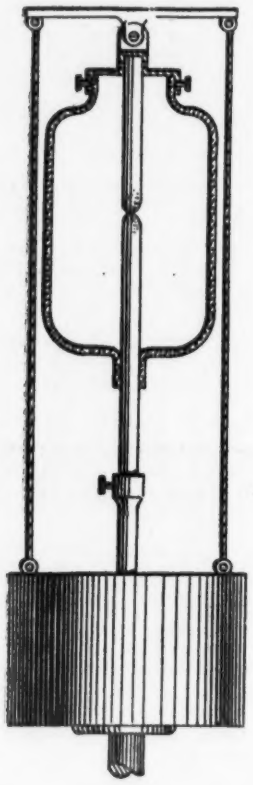
694,511. MOUNTING OF ELECTRIC BELLS; C. Woittequand, Charleville, France. App. filed March 5, 1901. Details of construction of the frame.

694,542. TELEGRAPHY; J. P. Gorton, Weston-Super-Mare, Eng. App. filed Oct. 31, 1901. For repeating from one circuit to another when the first circuit is subject to retardation, apparatus is so arranged that successive current impulses arriving at the repeating station will be transmitted in the form of well defined impulses.

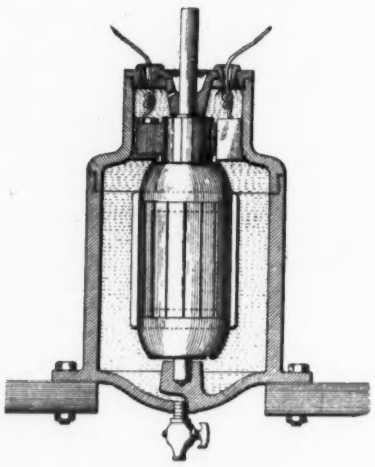
694,546. SELF-WINDING ELECTRIC CLOCK; M. Hoeft and E. Schultz, Berlin, Germany. App. filed Sept. 25, 1900. The circuit closer is constructed to be self-cleaning at the contact points.

694,582. PLUG OR BRUSH FOR CONNECTING WIRES OR BARS TO PIECES OF METAL; E. A. Richardson, Charenton, France. App. filed July 20, 1901. A rail bond in which the end of the bond is held in a conical slotted plug in the rail.

694,639. ELECTRIC MOTOR; T. B. Hatch, Menomonie, Wis. App. filed Aug. 7, 1901. The field magnet of the motor is a sealed case containing oil, which excludes moisture, air and dust.



694,410.—Electric Arc Lamp.



694,639.—Electric Motor.

694,658. ELECTROLYTIC PROCESS; J. Meurant, Liege, Belgium. App. filed Dec. 11, 1900. (See Current News and Notes.)

694,662. TELEPHONE EXCHANGE SIGNAL SYSTEM; W. S. Paca, Erie, Pa. App. filed May 7, 1901. (See page 474.)

694,673. TRANSFORMER; F. Schwedtmann and G. E. Wells, St. Louis, Mo. App. filed Aug. 17, 1901. The transformer is provided with air circulating pipes leading to a blower, which is started up when the current or temperature rises to a certain point.

694,677. CABLE HANGING HOOK; C. P. Seyler and P. H. Auxer, Cleveland, Ohio. App. filed Nov. 4, 1901. A looped wire hook and a flat band adapted to pass through the loop and have its ends held by the plies thereof.

694,699. ART OF REFINING COMPOSITE METALS; T. Ulke, Sault Ste. Marie, Canada. App filed Jan. 11, 1902. (See page 476.)

694,778. ELECTROMAGNETIC APPARATUS; D. Perret, Neufchatel, Switzerland. App. filed Oct. 16, 1901. The magnet spools are applied to the ends of a yoke-shaped iron bar which is flexible to permit the ends of the yoke to approach and recede from each other as the circuit is interrupted.

694,791. STEERING GEAR; R. E. Sack, Detroit, Mich. App. filed Feb. 17, 1900. The swinging movement of the steering axle throws resistance into the circuit of one or the other of two magnetic clutches which permits one driving wheel to move at a different speed from the other.

694,792. ELECTRIC CALL; J. Salmon, New York, N. Y. App. filed Jan. 31, 1901. Details.

694,806. OUTLET MEMBER FOR ELECTRICAL CONDUITS; R. M. Thomas, New York, N. Y. App. filed Jan. 26, 1901. A sleeve of solid metal having an interior thread for attachment to the end of the pipe and a lip extending over the edges of the pipe and provided with a protective coating of enamel.

694,810. ADJUSTABLE ELECTRIC LIGHT SUPPORT; E. F. Walters, Lehighton, Pa. App. filed Sept. 5, 1901. A telescoping arrangement in connection with a spring drum to take up the slack of the conductor.

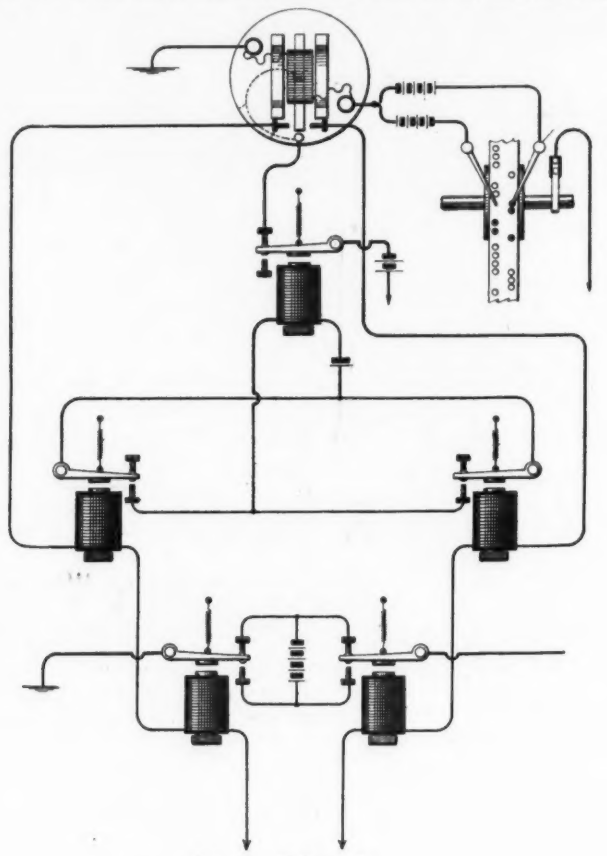
694,832. ELECTRIC METER; C. T. Claypoole, Sioux City, Ia. App. filed Jan. 18, 1902. The shunt circuit on which the meter operates is wholly within the casing, so that it cannot be tampered with.

694,855. ELECTRIC PROTECTIVE DEVICE; W. P. Hardy, Ottumwa, Ia. App. filed May 4, 1900. Two metallic conductors having the same coefficient of expansion are rigidly connected together and fastened at one end. When a current which flows through one of these conductors, rises above the normal, the heating effect warps the two conductors and closes an alarm circuit.

694,877. STOP MECHANISM FOR ENGINES; T. D. Millea, Springfield, Mass. App. filed May 9, 1896. A mechanical stop device set in operation by an electro-magnet.

694,902. GAS IGNITER; T. B. Wilcox, Newark, N. J. App. filed Aug. 2, 1901. A current is sent through a resistance consisting of platinum foil which when thrust into flowing gas, ignites the same. The chemical action of the gas on the platinum aids the battery in bringing the conductor to incandescence.

694,912. PLURAL FUSE CUT-OUT; C. J. Dorsey, Baltimore, Md. App. filed Aug. 30, 1901. A plurality of fuses all connected at one end with one side of a circuit can be connected with the other side by inserting plugs.



694,542.—Telegraphy.

694,913. SPEED RECORDING APPARATUS; R. W. Eaton, Brunswick, Me. App. filed April 17, 1901. An electric circuit which operates a puncturing device on a clock is closed at each rotation of a shaft and at the end of a certain period the number of punctures shows whether the normal speed was exceeded or lowered.

694,914. ELECTRIC APPARATUS FOR EXPLODING MINES; S. Evershed, London, Eng. App. filed June 4, 1901. An armature which closes the firing circuit is acted upon by the field magnets of the generator so that when the current rises to the firing point, the armature is at the same time moved to close the firing circuit.

694,918. TELEPHONE EXCHANGE; N. H. Holland, Brookline, Mass. App. filed Feb. 23, 1901. (See page 474.)

694,933. ELECTRODE FOR PURIFYING LIQUIDS BY ELECTROLYSIS; W. R. Chipman, New York, N. Y. App. filed April 29, 1901. (See Current News and Notes.)